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REPORT

OF

THE SELECT COMMITTEE

ON THE

GEOLOGICAL SURVEY.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

QUEBEC:
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1855.

REPORT.

The Select Committee appointed to report upon the best means of making public the valuable information already obtained by the Geological Survey, and completing it at an early period upon an uniform system, beg leave to report:

That they have diligently enquired into the subject referred to them, and in pursuing their investigations, they have necessarily had before them the whole subject of the Geological Survey; they have called for evidence from several gentlemen conversant with Geology and its applications in this Province, and have asked for and obtained the advice of distinguished Geologists in the neighbouring Union, the whole of which is herewith submitted.

The first branch of the enquiry referred to your Committee is the best means of making public the information already collected by the Geological Survey; but before submitting to your Honorable House any recommendation upon this subject, it may be desirable to point out what has been the actual progress of the Survey up to the present time, and what the nature of the materials at our disposal.

Since the first commencement in 1843, Mr. Logan and his assistants have traversed and examined every part of Canada, from Gaspé to the head of Lake Superior, in the uninhabited portions, following for the most part the course of the Lakes, the St. Lawrence, and the Ottawa, and their principal affluents, and in the settled parts penetrating farther into the interior.

The minuteness, with which the exploration of this immense tract of country has been conducted, has varied very much according to circumstances, as the means of access, the immediate requirements of the country, and the interest and importance of the formations under examination. In some cases, where the geological structure maintains an uniform character over large areas, as on the north side of Lake Ontario, little more has been done than to trace the boundary between the principal formations. In others, as on Lakes Superior and Huron, in the upper part of the Ottawa Country, and in Gaspé, the nature of the country, and the entire absence of reliable topographical surveys, rendered any other examination impossible in a limited time, except to trace the course of the principal streams, with such occasional excursions into the interior, as the Geological observations seemed to dictate; whilst in some, where the facilities were greater, and the field more inviting, considerable minuteness has been attained, as in the region between Lakes Huron, Erie, and Ontario, the country between the St. Lawrence and the Ottawa, and some parts of Lower Canada, south of the St. Lawrence. The result has been such, as to enable Mr. Logan to lay down with sufficient certainty the general geological features of the whole of Canada, and to fill up many of the more interesting parts in considerable detail.

From the absence of accurate maps, Mr. Logan and his assistants have, in almost all cases, been obliged to conduct a topographical survey, as well as an examination of the strata; a fact which should not be lost sight of, as having materially retarded the progress of the survey, but which at the same time has been of great use to the Province, in giving certain information as to rarely visited localities, and even in correcting erroneous surveys in settled parts of the country, as is acknowledge by Mr. Russell of the Crown Lands Department in his evidence,

Ques. 65.] who bears testimony to the great accuracy of some of Mr. Logan's surveys.

During these investigations many new fossils and mineral forms have been discovered, and new facts of great interest to Geologists have been brought to light; amongst the latter may be mentioned the crustacean tracks discovered by Mr. Logan in the Potsdam Sandstone; the chemical composition of certain fossil and recent shells, which had hitherto been thought exclusively to distinguish the skeletons of vertebrate animals; the parallelism of the disturbing forces throughout the Silurian, Devonian, and carboniferous eras; and more particularly, the researches on the metamorphism of rocks, which seem to establish with certainty, that not only the cristalline formations of the great Apalachian Chain, but also the still older rocks which separate the St. Lawrence from the Arctic Ocean, are merely statified sedimentary deposits in an altered condition.

Of more immediate practical interest is the knowledge gained of the mineral wealth of our country. Besides building materials of all kinds, and limestone, the discovery of which in some parts is of as much practical value as that of gold itself, there is the copper of Lakes Huron and Superior, the slates, marbles, serpentines, soapstones, and iron and copper ores of the mineral region south of the St. Lawrence, and the magnetic iron ores of the Laurentine formation, of greater extent and value than exist probably in the rest of the known world. Upon the whole, with the single exception of coal, the Canadas, on the testimony Ques. 37.] of Professor Hall, have been shewn to stand higher in respect of their mineral products than any of the surrounding states. All these and numerous other economic materials, a list of which is given in the report of 1849, 1850, and the description of the London Exhibition of 1851, if not actually first discovered by the survey, have been made generally known, the formations which yield them pointed out, and in many instances the localities, where they can be profitably worked, indicated.

Whilst the survey was in progress, a very large collection of specimens has been brought together, with the intention of illustrating, not only the science of Canadian Geology, but its practical application in the supply of useful materials, the whole of which are now deposited at the house of the survey at Montreal.

Such is the present result of the Canadian Geological Survey, and although much remains to be done, considering the vast extent of country under examination, the difficulties presented by the uninhabited state of much of it, the total absence of reliable topographical maps, and the short period of each year which our climate renders available for the field work, your Committee think they may pronounce with confidence, that in no part of the world has there been a more valuable contribution to geological science for such a small outlay, (hardly more than £20,000 in all.) In confirmation of this opinion your Committee would refer to the letter of Professor Agassiz, and the evidence of Professor Hall, [Ques. 5. and to the opinions of scientific men quoted by Mr. Logan, and Mr. [Ques. 101. Ques 3.] Hunt. They beg also to add two other quotations, as shewing the estimation in which our survey is held by men of science in England and France. "In Canada especially, there has been proceeding for some years one of the most extensive and important Geological Surveys now going on in the world. The enthusiasm and disinterestedness of a thoroughly qualified and judicious observer, Mr. Logan, whose name will ever stand high in the roll of votaries of his favorite science, have conferred upon this great work a wide spread fame."—*London Quarterly Review*, *October*, 1854.

"De toutes les colonies anglaises, le Canada est celle dont l'exposition est la plus intéressante et la plus complète, on peut même dire qu'elle est superieure à l'exposition minérale de toutes les contrées qui ont envoyé des produits à Londres; cette supériorité vient de ce qu'elle a été faite d'une manière systématique; il en résulte que son examen fournit des moyens d'apprécier à la fois la

constitution géologique et les ressources minérales du Canada. Cette circonstance vient de ce que notre collègue, M. Logan, qui remplit dans le Canada, les fonctions de *Geological Surveyor*, a présidé sur les lieux aux choix de la plupart des échantillons qui ont été envoyés à l'exposition, et qu'il les a classés depuis leur arrivé à Londres,"—*M. Dufrenoy membre de l'institut*, in the Jury Reports of the London exhibition.

It is mortifying to your Committee to have to report, that results of so much value are almost inaccessible to the public, and that a great proportion of the inhabitants of Canada, if not ignorant of the existence of the survey, are at least unacquainted with what it has achieved. The annual reports are presented to Parliament, and buried in the Journals of the House, except a few hundred copies, which are distributed by Members amongst their friends, so that the reports of two consecutive years rarely fall into the same hands. Professor Chapman, Ques. 49.] complains of the difficulty of procuring them, Mr. Lovell [Ques. 133. speaks of the frequent applications to him for complete sets, both at home and Ques. 109.] from abroad, and Mr. Bell, says that, so much is this want felt, that it has been proposed to reprint them in New York. Were it not for additional copies, which Mr. Logan orders at his own expense and kindly distributes, it is doubtful whether (apart from the Journals) there would be a hundred complete sets in the Province. Mr. Logan also, speaks of the demand [Ques. 85, 86, 87. for the reports, the imperfect knowledge in the country of what they contain, and the consequent verbal and written applications, which are made to him for information. As a further proof of the ignorance which prevails as to what has already been done, your Committee may mention, that the existence of a combustible material, closely resembling coal, in the rock at Quebec, which has lately occupied so much attention, is fully described, and the reasons why there is small probability of its being profitably worked given at large in the report of 1844, pp. 19 and 20. These facts speak for themselves as to the necessity of republishing the reports in some shape.

Another serious deficiency is the want of a map. Not only are the annual topographical measurements of the survey unknown, till the publisher of some new map obtains copies of them, but it is extremely difficult to follow a geological description without a map, and a student must colour one for himself from the reports, before he can get a clear knowledge of the geological features of the country.

Again there are many things which even the reports do not contain, were they accessible, viz: plates and descriptions of new and characteristic fossils, sections and illustrations of the disturbances of the strata, &c., without which a complete understanding of the subject cannot be obtained. We may mention also generalizations, and theoretical conclusions, deduced, not from the report of one season's work, but from a comparison of the whole, such as the investigations upon the metamorphic rocks already mentioned, which must be sought for in a perfect form in the papers communicated by Messrs. Logan and Hunt to the scientific bodies of Europe and the United States.

Lastly, the vast collection of minerals accumulated at Montreal, from insufficiency of funds to provide for their proper arrangement, lie in a great measure buried in packing cases in the vaults and sheds of the Survey Office.

With a view to remedying these defiencies, your Committee would recommend the immediate republication of the substance of all the former reports. The original documents will always be valuable in their present shape, and will be accessible for reference in the journals of the House; this does not, however, appear to your Committee to be the most convenient shape, in which the facts they record should be distributed, as a whole, to the country. From the partial nature of each season's examination, there is necessarily much repetition in the reports of succeeding years, when they record the progress over similar

ground. For the same reason, the reports, as they stand, do not follow up the subject either topographically, or geologically, and any person desiring information as to a particular formation, or a particular locality, would have to gather it out of several different reports. The absence of a map also has rendered detailed verbal descriptions necessary, which would only encumber the volume, if a map were at hand. Some portions too, as the inquiries into the alleged discovery of coal at Les Eboulements, are of temporary interest only, and need not be republished. There may also, though none occur at present to your Committee, be instances where subsequent examinations have corrected or modified opinions expressed in previous reports, and certainly there will be found general views, which are only partially developed in the works as they now stand. The course which your Committee recommend, would be, to publish all that is necessary of the old reports, revising, re-arranging, and if necessary, adding to them, so as to give a connected and systematic view of the geology of the Province, as far as it is at present known. This volume, which would not be a very large one, should be accompanied by a coloured geological map of the whole Province, upon a scale of from 20 to 25 miles to the inch, and should be illustrated with a few wood cuts of the most characteristic fossils, and, the most common crystaline forms of minerals, with plates of such geological sections as may be requisite to elucidate the subject, and, if necessary, with maps on a larger scale of particular localities, which may require more minuteness of detail to exhibit their structure, or the occurrence of mineral veins. There should also be a copious index of the localities reported upon, and another of economic materials, with a reference to the body of the work, where a fuller description of them and their geological relations, and geographical distribution, would be found.

The publication of the annual reports of future progress should continue as heretofore, with the addition of such wood cuts, sections, and detailed maps, as might be judged necessary to elucidate the report in an uniform shape with the volume above mentioned, to which they would, in fact, become an annual Appendix. In order to secure this uniformity, as the annual reports would be published by the House, and form part of the journals, the revised reports, though not on the journals, should be published in the same form.

Your Committee would also recommend the publication, in numbers, from time to time, as materials accumulate, of plates of new and characteristic fossils, with letter-press descriptions, together with such other illustrations, sections &c., as may be thought of scientific value, but not of a nature to accompany the reports as above mentioned.

In the Geological Survey of the State of New York the publication of these illustrations was delayed till the whole examination was complete; but for the reasons stated by Professor Hall, your Committee prefer [Questions 29, 30, 31. the former method. The only advantage of the latter is, that the plates would be published on a systematic arrangement, but if a little care is taken to keep this ultimate object in view, the information may be, at once, given to the world, without interfering with the arrangement of the plates, when the whole work is finished.

With regard to the distribution of these publications your Committee believe that great advantages would arise from the printing of a very large number, say, from 10,000 to 20,000 of the revised reports, and future annual reports, and from 2000 to 3000 of the plates and illustrations. The former should be distributed as follows:—The usual number to each Member of the Legislature, and, upon application, one copy to every University, College, Literary and Philosophical Society, Public Library, Mechanic's Institute, Grammar, Model, and Normal School, and every Common School and Municipality which has established a School or Municipal Library, also some copies to the Governments of each of our sister Colonies for distribution, and one to all the principal libraries and learned Societies in the United States and Europe.

In the distribution of the plates, which are not only much more expensive, but also of less general interest, one copy to each Member of the Legislature would suffice, the Common School and Municipal libraries might be omitted, and the number sent abroad might perhaps be reduced. These would, of course, be distributed gratuitously, but whatever decision may be arrived at with regard to the parties to be so supplied, your Committee think it expedient that a considerable number of both publications, should be for sale, at the lowest cost price, that being the only way in which they could often be procured by those most likely to make a profitable use of them.

Your Committee also recommend that increased means should be placed at Mr. Logan's disposal, to enable him, not only to complete the arrangement of the Geological Museum, upon the system explained in his report for 1852, but also to procure such additional assistance, as may allow of its being kept open to the public at stated hours, without interfering with the other duties of Mr. Logan himself, and the other officers of the Survey.

If these recommendations are carried out, your Committee believe that the first object on which they were instructed to report, viz: "How best to make available the information and materials already collected," will be fully secured. It remains for them to enter upon the second branch of their enquiry, "The best means of completing the Survey at an early period."

It must be at once evident, that if our Geological Survey is limited to its present establishment, many years must elapse before the great extent of country, embraced in the two Canadas, will have been examined in a manner at all comparable with the national Surveys of other countries. Even with the very largest increase to the department, which prudence would admit of, it would be impossible for many years, and indeed it would be neither necessary nor practicable, to attempt the same minuteness of detail, which characterizes the French and English, and a few other European Surveys. Nevertheless it appears to your Committee very desirable that the whole country should, within no very distant period, be efficiently examined, and that the rich mineral localities, with which it abounds, should receive more minute attention than has hitherto been found practicable; and they believe that there is no way, in which the annual expenditure of a few thousand pounds could be made to conduce so much to the material prosperity of the Province. Your Committee have directed a great part of their attention to this branch of the subject, and they find two different methods recommended for hastening the completion of the undertaking.

It has been proposed that the Upper and Lower Provinces should each have its geological survey, or that the whole country should be still farther subdivided. A similar plan was adopted in the State of New York, where four separate surveys were established; but the disadvantages of this system are numerous, and are explained in Professor Hall's evidence, to which [Questions 18. 19. your Committee beg especially to refer, and which appears to them conclusive against it. Time would undoubtedly be saved, but at the expense of much additional outlay, and less unity and perfection in the execution. The other plan, which your Committee very much prefer, is, whilst preserving the unity of the Survey, to make a considerable addition to the assistants in the different departments, with the view of relieving Mr. Logan from such duties as could be efficiently performed by others, and leaving him free to pursue his geological investigations, and superintend the whole.

To accomplish this object, the most important improvement would be to give him the means of ascertaining the correct topography of the region under examination. In England, where there are the Ordnance maps upon a large scale, showing every stream and road, and almost every building, with the greatest accuracy, a geologist has a sure foundation for his work, and has rarely to make any measurements or observations, except for the thickness or inclinations of the strata. In this country, however, no such aids exist; and as there

can be no certainty in geology without topographical accuracy, Mr. Logan, and his assistants are engaged, fully one half of the time they are in the field, in work which any land surveyor, under proper directions, would perform as well, and perhaps better. For details of the difficulties and delays experienced from this cause your Committee would refer to Mr. Logan's evidence. [Questions 47, 70 and 71. The employment of a proper surveying party, whenever required, with each geological exploration, would leave the geologist free to devote his time exclusively to his own researches, which would, in consequence, be more rapid, and more efficient, and the Surveyors employed would have opportunities of gaining geological information, which could often be otherwise turned to account.

It would also be advantageous to increase the number of persons employed as assistants and explorers: by their means the examinations might be very much extended, whilst the head of the survey would be able to devote himself to those sections of the country, where the peculiar formations seemed to require the greatest amount of care and scientific attainments. The latter class, of whom Mr. Richardson is the only one now employed, might perhaps be the most profitably increased. The necessary attainments for such a person, and the kind of work entrusted to him are explained in Mr. Logan's evidence. [Question 74.

Other branches or departments, might also be added to the survey with advantage, if sufficient funds were voted by the Parliament; but the object your Committee has had in view is to ascertain what addition, without any immoderate expenditure, would most tend to perfect the undertaking. In the state of New York a Palæontologist, a Zoologist, and a Botanist were employed; and latterly, an Agricultural department was added. The three last your Committee believe may be dispensed with; but although not regularly attached to the survey, the services of a Palæontologist will be required in preparing descriptions of fossils. Most of the European Governments have also organized a department of mines, either separately, or in connexion with the geological survey; a most useful branch, if means sufficient were attainable. To make the establishment of the survey quite complete, it ought, probably to consist of four or five departments. Geology, in its most confined sense, Mineralogy, Chemistry, Palæontology, and Mines. Each of these require special talents and opportunities, and a special training. Few men, who are familiar with all the refinements of modern Chemistry, can have had opportunites for the personal experience, which is necessary to judge of mineral lodes, and no human intellect can be expected to combine a thorough acquaintance with the endless forms of Mineralogy, and the 30,000 recognized species of fossils, together with a competent knowledge of the associated sciences of Chemistry, on the one hand, and Zoology, Botany, and Comparative Anatomy, on the other. In England and France, accordingly, where scientific men abound, and can give their aid without altogether interfering with their other avocations, these different departments are established, and filled by some of the greatest names in science. In this country, however, the material is not easily found, and the expense would probably be disproportioned to the results. A department of mines alone would require, in order to produce any useful results, an appropriation equal to all that has hitherto been allotted to the Geological Survey. It must also be borne in mind, that in those countries where special departments and schools of mines are organized, mining operations have been largely carried on for centuries, and the workings afford the means of examining the modes of occurence of mineral lodes, the indications which are most trustworthy, both in the search for them, and for judging of their value of studying, in short all the facts, which constitute the science of mines, as a distinct branch of geology. In this country, however, the case would be very different; and the labours of a mining department would necessarily be confined at present to the search for the surface indications of mineral wealth below. Even on the lands of the Crown it may well be doubted, whether it would be prudent to undertake such preparatory workings, as would alone justify any confident

opinion upon an object so capricious as a metalliferous vein, and on private property, it would clearly be beyond the province of the state. It is not, however, what might be desirable with unlimited funds, but what is practicable in the present condition of the Province, that your Committee would press upon the attention of Your Honorable House. The three first branches of a Geological Survey, as above mentioned, are already well represented by Mr. Logan, Mr. Murray, and Mr. Hunt, and as Mr. Logan has been himself professionally a miner and metallurgist, the last branch has been in no way neglected. Should it, however, be practicable to increase the establishment materially, it might, without forming a special department, be advisable to add a second assistant, more particularly charged with the examination of mineral veins; and as the occasional services of a professed Palæontologist will certainly be required, this branch may perhaps be combined with that of resident assistant in charge of the Museum hereafter recommended; they would not advise the formation of a special mining department at present. In any case your Committee would strongly recommend, that the unity of the whole survey should be maintained, by keeping it under the direction of one responsible head.

The Museum, besides the collection already made, and additions from the results of future explorations, should be enriched with foreign specimens, so as to render it the means of a complete practical study of geology. Your Committee also believe, that it would greatly conduce to the progress of geological studies in the Province, if, during the progress of the survey, it were a general instruction to procure several specimens of the more important and rare fossils and minerals met with, with the view of supplying other public Museums in the Province, and of exchanging with foreign scientific institutions. The difficulty of transportation in explorations of remote districts will, your Committee are aware, render it difficult to carry out this recommendation to the fullest extent, but it is an object which should always be kept in view, and should be acted upon as far as possible. Hitherto all the books, and almost all the instruments, used by the survey, have been the private property of Mr. Logan and his assistants, but in so important a public institution, a library should be kept up, containing the best standard works and books of reference connected with geology and the allied sciences, and the necessary instruments should be provided by the Government. In the arrangement and classification of the present collection, some additional aid will be absolutely necessary, and your Committee recommend that a resident assistant should be permanently added to the establishment, to take charge of the Museum, and assist in the general business of the department, which now occupies an undue share of Mr. Logan's valuable time.

With the increased efficiency which these additions would impart to the survey, your Committee believe, that in a few years our knowledge of the resources of the country would be greatly extended. The assistance, however, which may be obtained from quarters, not immediately connected with the department, should not be neglected; a taste for Geological studies, it may reasonably be expected, would be much promoted by the general circulation of the reports, by the accessibility of the Museum, and the encouragement of local institutions of the same character, a taste which, from the evidence of Mr. Bell, and of Mr. [Question 114.
Logan himself, seems already to be developing itself. Of the extent to which private enquirers may contribute to the general information, examples are given by the latter gentleman. Every encouragement should be given to [Question 77.
such voluntary assistance, and it would be desirable to invite it by questions framed with that object, and circulated with the reports. The instructions formerly given to the Deputy Provincial Surveyors on that head might, from their opportunities, have been expected to have produced more fruit; and it would be desirable again to call their attention to the subject, and to issue some short and simple instructions how and what to observe. It might even be advisable for the

future to require every Deputy Surveyor, before his appointment, to pass an examination in the rudiments of geology.

With the same object in view, your Committee believe that advantage might be taken of the surveys for railroads, in ascertaining more accurately the topography and levels of the country, which are most essential to a correct view of its geology. At present these surveys form detached facts, difficult of access. Your Committee would combine them for the public use, by requiring every railway company hereafter to be formed to furnish, without charge, to the Geological Survey, a copy of their plans and sections, and all companies now incorporated to furnish similar information, when required, at the expense of the Geological Survey. In order to connect these Surveys together, and as a basis for future operations, your Committee would also recommend, that a permanent mark should be inserted in some public building, or otherwise, at several convenient points throughout the country, from which future levels may be reckoned, and that the correct latitudes and longitudes, and relative levels of such points, be ascertained as soon as possible.

The importance of an accurate geological acquaintance with the country is so universally acknowledged, that it is unnecessary to do more than point out some portions of the evidence, which shew the im- [Questions 32, 33, 85, 89, 107. mediate practical results; but as an apparent misapprehension exists in some quarters as to the objects of such a national undertaking, your Committee may be pardoned for making some additional observations. The discovery of valuable economic materials speaks for itself, although even here it may be doubted, whether the relative importance of the minerals indicated is always justly appreciated, whether the crystalline limestones of the Laurentian series have not been of more real value, than some discoveries of a far more imposing character. But where the outline of some formation of no very obvious economic use is accurately traced for many miles, when minute and laborious investigations are carried on of the undulations, contortions and disturbances of other strata, with exact measures of their thickness and dip, and when the greastest attention is paid to the fossils they contain, some people are apt to think that the Geologist might be more usefully employed. They draw a distinction between practical utility and scientific interest. The ultimate object, however, of all science is practical utility; it is only a systematic, instead of a desultory search for valuable facts. The discovery of some useful material at a particular point would be an isolated fact though perhaps of great importance to that locality; but combined with a correct scientific knowledge of the geology of the country, it would be not only available over an extensive region, but would be the contribution of a valuable truth to the whole world. Instances of this intimate connection between science and economics will be found in the evidence. [Questions 34, 35, 55, 92, 93.

Again different individuals, according to their several pursuits, expect information of a special nature from the Geological department. The agriculturist wishes to have every bed of marl pointed out, and an analysis of every soil; the architect or engineer calls for details of accessible building stone, brick-clay, and hydraulic lime; while the miner wants information of where mineral veins occur, the abundance of the ores, their chemical constituents and the per-centage of metal. Now, details of this description for the whole country cannot be expected, especially where it is to such an extent uncleared. The duties of persons engaged in a Provincial Survey is to ascertain and make known with such accuracy and detail as is practicable, the physical structure of the country; to record the localities where any valuable material has been observed, with its probable extent, and the direction in which its recurrence may be expected, and in the case of mineral veins, to describe their character as far as visible, the apparent richness and abundance of the ores, and the indications which the country exhibits of the frequent recurrence of the lodes. They cannot point out every bed of marl or brick-clay, or pause to search out every promise of a mine, or still

more the probability of its being worked to commercial advantage. The practical details must, of necessity, be left to private enterprise to accomplish. No appropriation by Parliament, no staff of geologists, however extensive, would suffice for the whole Province if more were expected. The public should provide general information for all; the individuals who are to turn it their private profit, must supply the rest.

In conclusion your Committee beg leave to submit the following summary of their recommendations, with an estimate of the annual expenditure, which would be required to put them in practice.

(1.) The republication of not less than 20,000 copies of the revised reports, with a coloured map. The expense of this is already provided for by the additional appropriation of £2000 in the estimates of last year.

(2.) The publication of the same number of the annual reports of future years uniformly with the above.

(3.) The periodical publication of 4000 copies of plates, and descriptions of fossils, &c.

(4.) The gratuitous distribution of the two former as follows: 4 copies to each Member of the Legislature, copies to the Governments of all British Colonies, and the East India Company, for distribution by them to public libraries and scientific institutions, and one copy to every University, College, Literary and Scientific Society, Mechanics' Institute, Library Association, Grammar, Normal and Model School, Municipal and Common School Library in this Province, applying for the same, and to the principal learned Societies in the United States and Europe. The gratuitous distribution of the latter to be confined to one copy to each member of the Legislature, the copies to Municipal and Common School Libraries to be omitted, and the number sent to British Colonies and foreign Societies proportionately restricted. The remainder, after keeping some on hand for parties subsequently added to the gratuitous list, to be for sale at cost price.

(5.) The establishment and maintenance of the Museum and Library upon an efficient footing.

(6.) To provide for the supply of Geological and Mineralogical specimens to other Museums.

(7.) The employment of topographical surveyors and their parties, to assist in the Geological Surveys, when judged necessary.

(8.) The employment of two or three additional explorers.

(9.) The employment of a resident Assistant, as keeper of the Museum, and in the general business of the office,

(10.) The employment of a Second Assistant Geologist, charged more especially with the exploration of mineral localities. The Committee wish it to be understood that in the present state of the country they consider this the last essential addition to the establishment, and unless ample funds are provided, they would not advise it, to the prejudice of any other of their recommendations.

(11.) The encouragement of voluntary assistance by the publication of questions and short instructions how and what to observe and collect.

(12.) Securing the aid of Deputy Provincial Surveyors, and requiring all persons admitted as Surveyors for the future, to pass an examination in the rudiments of Geology.

(13.) The establishment of certain points in different parts of the country, as a basis from which local surveys may be reckoned.

(14.) Requiring all Railway Companies to furnish plans and sections of their surveys.

Estimated annual cost of the Department as compared with the present expenditure.

	Present.	Future.
Salary of Director of Survey	£555	£555
" of Assistant Geologist	333	400
" of Chemist and Mineralogist	300	400
" of Resident Assistant		200
Explorers	120	450
Field expenses of two Surveys	600	600
Topographical Surveyors and their parties		750
Publications of fossils, sections, &c., including services of a Palæontologist		800
Laboratory	100	100
Museum		200
Books, Instruments, &c		200
Fuel, Messenger, and incidental expenses	275	345
	£2,283	£5,000
Assistant more particularly charged with examination of mineral veins, and his field expenses		1,000
		£6,000

The whole nevertheless, respectfully submitted.

JOHN LANGTON,
Chairman.

Committee Room,
Legislative Assembly,
29th March, 1855.

MINUTES OF EVIDENCE.

ORDER OF REFERENCE.

LEGISLATIVE ASSEMBLY,
TUESDAY, 26th September, 1854.

Resolved,—That a Select Committee be appointed composed of

MR. LANGTON,
HON. MR. MORIN,
HON. MR. ROLPH,
HON. MR. CAMERON,
MR. VALOIS,
MR. RHODES,
MR. FERGUSSON,
MR. BELL, and
MR. TACHE,

to report to the House the best means of making public the valuable information already obtained by the Geological Survey, and of completing it at an early period upon an uniform system; with power to send for persons, papers and records.

Attest,

W. B. LINDSAY,
Clerk of Assembly.

Thursday, 28th September, 1854.

In Committee on the Annexed Order of Reference.

MEMBERS PRESENT.

Mr. Langton,
The Hon. Mr. Cameron,
Mr. Rhodes,
Mr. Bell, and
Mr. Tache.

Read the Order of Reference.

JOHN LANGTON, Esquire, in the Chair.

The Committee deliberated.

Ordered,—That Professor *Chapman* of the University College of *Toronto*, be summoned for Tuesday, the 10th proximo.

Ordered,—That the Chairman be requested to write a letter to Professor *Hall*, of Albany, in the State of New York, requesting his attendance before the Committee on the same day.

After further deliberation, the Committee adjourned to the call of the Chair.

Wednesday, 11*th October*, 1854.

Committee met.

MEMBERS PRESENT.

JOHN LANGTON, Esquire, in the Chair.

Mr. Bell,
Mr. Rhodes,
Mr. Fergusson,
Mr. Valois, and
Mr. Tache.

Professor *James Hall*, of the City of Albany, examined:—

1. Have you been engaged in conducting any of the State Geological Surveys of the American Union?—*Ans.* I was engaged in conducting a part of the Geological Survey of New York, from its commencement in 1836, to its close in 1843, and since that year I have conducted the investigations in the Palæontology of the entire State, in connexion with the Geology of the fossiliferous rocks.

2. You are the Author of various works on Geology?—*Ans.* I am the Author of several Annual Reports, or Reports of Progress in the New York Geological Survey; of a final Report upon the Fourth Geological District of the State of New York; of two volumes upon the Palæontology of the entire State; be-

sides various papers upon Geological subjects, and contributions to the Geological Reports of the Lake Superior Land District, being the results of my own investigations upon the Silurian and Devonian rocks of that region. I have also contributed the Geological portions to several Reports of Explorations made by the General Government of the United States.

3. Have you had an opportunity of ascertaining what is doing in other States of the Union in this respect?—*Ans.* I have, both from an intercouse with the Geologists of those States, and from having been in several of the States where Geological Surveys are in progress, for the purpose of making personal examinations of the Geology of those States.

4. Are you aware that a Government Geological Survey has been instituted in Canada?—*Ans.* I have been acquainted with this fact from the commencement of the Survey.

5. Have you had an opportunity of ascertaining the progress that has been made on the Canada Survey, and what is your opinion of that progress and the importance of the work?—*Ans.* I have had an opportunity of knowing much of the progress of the Canada Geological Survey from its commencement, and I have a very high opinion of the character and value of the work which has been accomplished, as well as of its importance to the Province, both in its Scientific and Economical relations. To sustain this opinion I may mention that the Reports are sought after with great avidity, not only by scientific men, both Geologists and Chemists, but also by those persons who are giving especial attention to utilitarian objects, or to the Geographical distribution and the application of Economical mineral resources of the country generally; and not only is this true of the people of the Province, but also of the citizens of the United States, many of whom look to the Reports of Progress in the Canada Survey, as furnishing the best, and indeed, only guide to the distribution, mode of occurrence, and Geological relations of these Economic substances.

6. What in your opinion would be the best manner of placing the information and materials that have been collected on the Canadian Survey before the Public?—*Ans.* In reply to this question, several modes might be suggested; but one, which appears to me such as would meet the wants of the public, is the following,—To publish in one or more volumes, an account of the Geology of the Province, which may be a revision and condensation of the Reports of Progress, with such illustrations by Geological Sections, Maps, Fossils, etc., etc., as may be required for the proper elucidation of the subject. Accompanying this volume should be a Geological Map of the Province on a scale sufficiently large to represent all the Geological formations in their entire extent, each formation being distinguished by a different color. This map might also be accompanied with a small Pamphlet, describing briefly the character and extent of the Formations as represented on the Map by different colors. It would add also to the value of the work, if a list of the Economical Products of each formation could accompany these descriptions with reference to the more important localities; referring also to the pages of the Report where more full descriptions of the particular substances are given, together with their Geological relations and Geographical distribution throughout the province. This Pamphlet or small Volume would be, in fact, an Index to the more complete Report; and if thought proper a much larger number might be published and distributed then of the larger work. It would be very desirable, however, to have Copies of the complete work and the Map so distributed, either by placing it in all public Libraries, or by other means better known to your Committee, that it would be accessible for reference to every person in the Province. In addition to this means of placing before the public the information already obtained, I would

strongly recommend that the Museum already commenced, be advanced as rapidly as consistent with the other duties of the Geologist. The object in this collection should be the formation of a Museum of Economic and Scientific Geology, where specimens of all the Mineral products of the Province should have a place; and where those of Economic interest should be presented in a proper arrangement, not only in their natural state, but also in their wrought or manufactured condition. In separate Rooms should be arranged the scientific collection, or that part of the Museum shewing the Products of the Country in their Geological order or Chronological succession, including the characteristic Minerals and Rocks of each formation, and their mode of occurrence and association, whether of Economic value or otherwise. The stratified rocks would be arranged with their characteristic fossils and all other indications by which they may be studied or recognized in the field. This Museum should be open to the public, at certain stated times, who would then have the means of seeing Specimens of the various products of the country, and of comparing Materials of the same kind from different localities, thus availing themselves of all the information to be obtained from these various sources for their own advantage, and for the public benefit. This plan would render available at an early period a great part of the information and materials already collected by the survey. I would also recommend that provision be made for the Annual or Periodical publication of other facts and illustrations not indicated above. These would consist of certain Maps representing portions of the country, requiring more minute details of Geological structure, the occurence of Mineral veins, etc.; sections of the Strata for the illustration of the Geological position and relations of the different beds and their contained Mineral products, together with descriptions of the same; the results of Chemical analyses of Minerals and other materials, both of Economic and Scientific interest. In the department of Palæontology, an accessary so emphatically necessary to the perfection of a Geological survey, and to the true interpretation of the position and sequence of Strata, there should be published from time to time in successive numbers or decades, descriptions and illustrations of new and remarkable species of Fossils which may have been discovered in the course of the Geological Survey of Canada. I would strongly recommend this mode of publication as the materials accumulate, since by such a course the Canadian survey will receive due credit for such discoveries, and confer a benefit upon science by their speedy publication; whereas by leaving the publication till a later period, the same discoveries may be made and published elsewhere.

7. What appropriation do you think would be sufficient to bring out the result in a creditable manner?—*Ans.* The immediate appropriation necessary for publishing the Volume of Revised Reports and the Geological Map recommended, would depend on the number of copies printed. For two thousand copies of the Volume we may estimate £500. For a Map of beyond this number the cost would be proportionally less, since the cost of composition for the letter press, and the engraving of the Map, would have been incurred for the first number, and included in the estimate.

8. What annual appropriation do you think would place the Survey upon such a footing as to carry it on efficiently?—*Ans.* In order to carry on the Survey efficiently some assistance is necessary in the Topographical department; and to place the working of the Survey on a proper footing, to carry forward the Museum, and to provide for the periodical publication of the results of the investigations in a proper manner, as before indicated, an annual appropriation of not less than £5000 will be necessary.

9. In the publication of the results of the New York Survey, do you give an account of the Economic Materials to be found in the State, separate from the rest of

the Reports ?—*Ans.* In the publication of the results of the New York Survey, an account of the Economic Materials was given immediately after the description of the formation to which they respectively belonged, or in which they occurred, usually under a separate head of "ECONOMICAL MATERIALS." To some extent also this information regarding Economical Materials was grouped under the heads of the several Counties of the State ; in order that those persons who wished to acquaint themselves only with the materials of economic value within their immediate reach, could have an opportunity of thus obtaining the information. I would not recommend however that the Geologist be required to give a full description of the Geology and economic resources of each County in the Province. It appears to me, that after the condensed Report and Map shall have been published, the details respecting the economical resources, the character of the Soils dependent on the Geology, would form a very appropriate and useful object for the Agricultural Societies of the several districts. This would add new subjects of interest and value for such societies, and should their members find any difficulty in perfecting such Maps or Charts, they could obtain all the necessary information from the Director of the Geological survey and his Assistants.

10. Do you see any advantage in publishing the Economic part separately ?—*Ans.* I can perceive no especial advantage in publishing the Economical part of the Report separately, except so far as indicated in my reply to Question 6, and for reasons there given. I do not believe that the simple indication of the occurrence of Economical Materials can have any great value, except in connexion with descriptions of the Geological formations, by which their range and extent are brought out. The distribution of these materials could not be properly explained without an amount of detail, equivalent to a description of the Geological formation to which they belong, and of its range and extent throughout the country. It appears to me therefore, that something like an index, with names of substances, their localities, etc., and references to the Report, would meet all the requirements of a separate publication for the Economical part of the Survey. The hand book to accompany the Geological Map, recommended under a previous answer, would fully meet this want.

11. Is the Geological Survey of the State of New York completed?—*Ans.* The field labor, and the publications of the several departments of the Geological Survey of New York, have been completed ; with the exception of that part relating to the Palæontology, which is still in progress.

12. What is the area of the State of New York as compared with Canada ?—*Ans.* The area of the State of New York is something less than one sixth part of the area of Canada ; the State of New York containing less than 50,000 square miles, and Canada above 300,000 square miles.

13. What annual appropriation was made in the State of New York for the purposes of the Geological Survey ?—*Ans.* The appropriation for the Geological Survey of New York, including Zoology and Botany contemplated an annual expenditure of $20,000. The actual annual expense may have been a little less than this sum.

14. Did that appropriation include the expenses of publication ? and what were the number of copies published ?—*Ans.* The sum mentioned, included no part of the expenses of publication ; the Reports of Progress being printed by order of the Legislature and paid for, from a different fund. The number of copies of these Reports varied in different years from 5,000 to 10,000, and I have an impression that in one year they amounted to 20,000 or 30,000. The number of copies published of each volume of the Final Reports, has been 3,000.

15. What has been the whole cost hitherto?—*Ans.* The whole cost hitherto, including the expenses of Exploration, publication of Annual Reports, and of the Final Reports, together with the Museum, has been about $500,000.

16. During how many years was the Survey in progress?—*Ans.* The Survey was in progress in all its Departments from 1836 to 1843, since which time the departments of Agriculture and Palæontology have been continued. The former of these was finished during the present year; the latter is still incomplete.

17. What staff had you in New York during the progress of the Survey?—*Ans.* The State was divided into four districts, to each of which was assigned a principal Geologist and an Assistant; in the whole, four principal Geologists and four Assistants; one Mineralogist and an Assistant, for the entire State; one Palæontologist for the entire State; one Zoologist and an Assistant or draughtsman; one Botanist; making a total of fourteen persons. The department of Agriculture was not organised till 1843.

18. Would you recommend a similar plan of dividing the Survey into different sections, under different persons to be pursued in our case?—*Ans.* I would not recommend, by any means, a similar plan of subdivision into districts, to be under the direction of different persons. The disadvantages are numerous, and as the result has shown in New York, the Geological portion is far from having the proper unity of plan and object. The importance of adopting some uniform Nomenclature created the necessity of a compromise after some of the rocks and groups had been described in the annual Reports under different names; and in this compromise we were compelled to admit the existence of a system of rocks which the world is gradually repudiating. There is a further disadvantage in such a plan; some of the formations extend over two or more of the districts, and therefore it happens that the discriptions of these are repeated two or three times in different Reports. The chief objection however to such a subdivision I conceive to be the impossibility of having any unity of design in the execution of the work; either in the preliminary explorations, or in the publication of the Reports; while the expense is very much enhanced. Whatever advantages may attend the plan, I regard them as far from being commensurate with the evils.

19. What advantages do you think would result from continuing the system we have pursued?—*Ans.* The advantages which will result from continuing the present system of your Survey are very numerous; a few points only will be sufficient for the present object. By this system you secure a uniform plan of operations in the field, each portion receiving its due share of consideration; and from being under the direction of one mind much time and expense is saved in the exploration and examination of the rocks, since the same formation is traced throughout its whole extent, and described together, saving a great repetition, and also enabling far better descriptions to be given of each formation as a whole, than can be obtained by several observers working independently of each other. This plan enables the Director of the Survey to compare the results, over the entire Province, and decide what portions are deserving of especial investigation; and finally, the results, when published, will be more clear and concise, and present the evidence of unity of plan and purpose. It may be observed, also, that following the system adopted in New York, you would require for your greater area *six times* the number of persons employed in New York, if a similar area were apportioned to each person, forming therefore a Staff of about Fifty persons. By such a plan it is easy to be perceived that the cost would be greatly increased over the present expenditure.

20. Will you state the different departments into which your Survey was divided?—*Ans.* The Departments recognised, each of which was independent of the other, were, Geology, Mineralogy and Chemistry, Palæontology, Zoology, Botany, and ultimately Agriculture. The department of Geology recognized four independent Officers, or one to each of the four Districts.

21. Do you think any great advantage arose from the Zoological department?—*Ans.* I am not aware of any advantages, in an economical point of view, derived from the Zoological Department. For the purposes of science, and for teaching, it has made the subjects of this Department available; and has given to all, the means of learning the natural history of all animals inhabiting the State of New York.

22. Do you think any great advantage arose from the Botanical Department?—*Ans.* I do not know of any economical advantages derived from the Botanical Department. The plants of the State of New York were before pretty well known, still this work will facilitate the study of Botany by its elaborate descriptions and illustrations; copies of this work, with all the others, being distributed to the Academies and Colleges as well as among the people generally, making it accessible to all.

23, Were there any important results from the Agricultural Department?—*Ans.* In reference to this question it might be well for me to express no opinion. The opinion of some leading practical Agriculturist in New York would be more valuable than my own.

24. What may have been the probable expense of these three Departments, together with the additional cost of publication arising from them?—*Ans.* From the best means of estimating within my reach at the present time, (from the number of volumes, and recollecting the approximate number of plates in each) I should say that the whole expense of these departments has been between $225,000 and $250,000; not less than the former and probably not exceeding the latter sum; about half the cost of the Survey.

25. Do you think it would be convenient and practicable to publish the Geological Maps of Canada upon a scale and on a system uniform with those of the State of New York?—*Ans.* The greater extent of Canada would render it inconvenient if not impracticable to publish a Geological map upon the same scale as the State Geological Map of New York already published. But since the Geological formations in New York and the adjoining States are uninterrupted and continuous into Canada, it is very desirable to have Geological Maps of this Province and of those of the States adjoining it, published upon the same scale, and upon a uniform system of coloring and nomenclature for the different Geological formations. I conceive also that it would be very desirable to adopt, as far as practicable, the system of colors and in the maps of the Geological Survey of Great Britain. The advantages of such a course will, I think, be obvious.

26. Are you aware of any Geological Maps being published in the other States adjoining Canada, and are you aware of any Geological Surveys in progress or in contemplation in the United States?—*Ans.* A Geological Map of New Hampshire has been published, and a Geological Map of the Lake Superior Land District, which includes a part of the southern Peninsula of Michigan. Of the other States adjoining Canada no separate Geological Maps have been published, so far as I am aware. The State of Vermont has a Geological Survey in progress, but I believe no Map has been published. I have had in preparation a Geological Map of the United States east of the Rocky Mountains, originally intended to accompany the Palæontology of New York, for the purpose of showing the geographi-

eal extent and distribution of the Palæozoic rocks in the United States. This map is nearly completed and will probably be published within the ensuing year. A Geological Survey of the State of Wisconsin was authorised by the Legislature nearly two years since, and is now in progress. A Survey of Illinois has been in progress for more than two years. In Missouri a Geological Survey has been in progress for two years. The Legislatures of Kentucky and Tennessee during their last Sessions passed laws authorising Geological Surveys which are now in progress. Similar surveys are contemplated in other States, and will doubtless go into operation within one or two years.

27. What is the scale of the New York map? *Ans.*—The scale of the Geological Map of New York is about twelve miles to the inch.

28. About what scale would you recommend as sufficient to display the Geological structure of Canada? *Ans.*—I would recommend a map of twenty-five or thirty miles to the inch.

29. Would you recommend the illustrations of our Geology to be published at once in numbers as they can be got ready, or would you delay the publication till our Survey has been more nearly completed, so that it could be arranged in a more systematic manner? *Ans.*—I would recommend that the Illustrations of the Geology of Canada be published in numbers or parts, as rapidly as the materials can be prepared; and by no means to wait the completion of the examinations. I may add that this course does not prevent the final arrangement of these materials thus published, as a whole; and all the illustrations such as Maps, Profiles, etc., which constitute a large part of expense, will be used in any final arrangement for publications, whenever the work is completed. By adopting this course more time is given to engravers, and the work is better done than if a large amount be pressed forward at one time.

30. What plan was pursued in the State of New York in this respect? *Ans.*—The plan has been to wait the completion of the examinations, in order to produce the work in uniform large volumes.

31. What do you consider the several advantages of the two methods? *Ans.*—The advantage of publishing at once any new facts, or results, is that the information as soon as obtained is made available for the advancement of the subject to which it belongs. The country and the author obtain immediate credit for the investigations. The advantage of the other method, is that by a large accumulation of materials before publication, a more general or systematic classification may be adopted before the facts are presented to the public. In those departments of science already extensively known and where few new facts of interest or importance are anticipated, this plan is to be recommended. But on the other hand, in a subject like Geology, in which new facts and conclusions are likely to result, this mode is attended with great disadvantages to the author, who by being compelled to wait a long time for the accumulation of materials for a large volume, may thus lose to himself, and to the country which employs him, the credit and advantages to which these discoveries are entitled; since they may find their way to the public through other channels; and the original discoverer may at last appear in the position of producing a work which is not original. One great advantage arising from the plan of publishing in numbers or parts, according to the present system of the British Geological Survey, is that the total expense of the work is extended over a longer period of time, and will never demand any immediate large appropriation of money, as is required by the other plan. At the same time a better character of work is likely to be secured in the engravings; since by having a longer time it can be accomplished by fewer hands and therefore the services of well trained and experienced Artists can be secured for the whole.

When also the fact is regarded, that the results will be placed at once before the public, and that the Canadian Survey will always receive the credit for such original discoveries, which might be lost by delaying till the completion of the work; it appears to me that no other arguments are necessary.

32. Are there any great practical and economic advantages to be expected from Geological Surveys, such as those in Canada and NewYork ? *Ans.*—I conceive that there are immense practical advantages to be derived from such Geological Surveys. The determination of economic materials in the sequence of rocks and the delineation of their geographical distribution, immediately puts the inhabitants of a country in possession of a knowledge of their Mineral resources, and enables them to decide where they can best establish those manufacturing or other industrial occupations, which will render such resources available for the practical purposes of life. It would be easy to cite numerous instances of this kind.

33. Can you illustrate this by facts within your knowledge in the State of New York or elsewhere ? *Ans.*—The Survey in New York has resulted in tracing out the limits of formations having magnetic iron ores, both in the Northern and Southern parts of the State, and in the former, a much larger area containing these ores, as well as a much greater extent of the individual beds than before known, have been indicated. The inexhaustible character of these beds of Ore has likewise been demonstrated. It has shown the limits of the formations containing the red Iron Ores, known as oolitic or fossiliferous Iron Ores ; and indicated the line of country along which they may be sought with success. Advantage has been taken of this information to open the beds of Ore at numerous points for the supply of smelting establishments, not only for the immediate neighbourhood, but these Ores have been sent by Canal and Railway to others at a distance of one or two hundred miles. The source of the productive Brine springs has been shown, and the limits of the geological formation in which they have their origin ; and it has been proved to be entirely distinct from another formation, with which it had previously been confounded, and in which unprofitable borings for salt water had being made. The limits of the Gypsum formation, in the upper part of the Onondaga salt group, which was not previously understood, have been pointed out, to the great Agricultural and Commercial advantage of the Country along its range. The several positions of those formations containing flagging stones, building stones, hydraulic limestones, &c., &c., have been indicated ; and much capital has since been embarked in interprises for the development and manufacture of these materials. Some of them, as flagging and building stones, have been carried beyond the limits of the State, into Ohio and Illinois ; and flagging stones from Northern New York and from the Hudson River, and from the Hudson River valley, more than one hundred miles from the sea, are now extensively supplied to the cities along the Atlantic coast. If necessary, particular instances might be cited where quarries of Slate, Building Stones, and other materials, have been opened expressly from indications, furnished in the reports of progress of the Surveys of New York and of Pennsylvania. The same is well known to be true of Canada ; and the knowledge of Economic Materials, derived from Reports of the Geological Survey of the Province, has been frequently applied in the selection of Slate Quarries, Limestone and other Building Materials, as well as serpentine, Soapstone, Iron Ores &c. One of the greatest practical advantages resulting in New York I conceive to have been the proof, that no valuable or workable Coal exists within the State. This fact, though of a negative character, has forever set at rest all explorations for coal, while it has been ascertained, that during fifty years previous to the commencement of the survey, not less than One Million of Dollars had been expended in abortive search for Fossil Fuel, where a well informed Geologist would have at once pronounced the undertaking useless, and certain to prove a failure.

34. Have there been any important scientific results from the New York Survey in the establishment of new Geological facts? *Ans.*—One very important scientific result arising from the New York Geological Survey has been the clearness and certainty of the sequence established from the oldest fossiliferous rock to the base of the coal formation. The survey also proved that valuable brine springs exist without great beds of rock salt; and that both salt and Gypsum are products of the Silurian period, or of the older stratified rocks; while previously it had been believed that they belonged exclusively to the New Red Sandstone, or to more modern Geological formations. Before this time it was supposed that the Gypsum and brine springs of New York were indeed of the New Red Sandstone formation; and it was consequently supposed that coal might be found beneath these rocks as in Europe. Borings to discover it were recommended. The evidence from fossil characters soon proved however the futility of such an expectation. Thus in this instance *mineral evidence* set the public wrong, and *fossil evidence* corrected the error. Again, the occurrence of a rock known as the Oneida conglomerate was, from its mechanical structure, believed to be identical with the Millstone grit of England, which underlies the coal; and examinations for coal were accordingly recommended and I believe to some extent made. From the Fossils in the beds above and below this rock it has been proved to belong to the older Silurian beds. Thus in this case also Mineral evidence misled the public, and Fossil evidence corrected the error. In the first lessons in Geology which I received, it was taught that the Trenton limestone was identical with the Metalliferous or Carboniferous Limestone of England. And from this belief, with the almost immediate succession of the Oneida conglomerate just mentioned, the presence of coal was inferred, another error similar to the former which has been corrected by the subsequent study of Fossils. It will thus be seen that every scientific result has equally important bearings upon questions of economic interest.

35. Do you consider a sound basis of scientific investigation very important in leading to practical results? *Ans.*—I would answer most emphatically in the affirmative; I conceive that no practical or economical results of great value are likely to arise except those based upon Scientific investigations. A search for ores, or any other economic product of the earth, including the metalliferous veins, can only be rationally made through a knowledge of the Geological structure of the Country. So true is this, that but for the application of Geological science, these discoveries would be, as they were centuries since, the result of accident or experiment; and Mineral researches and Mining would be placed under the dominion of the empiric. There can be no systematic mining without Geological knowledge, nor without an intimate knowledge of the particular geological formation in which the mineral or ore is sought, and its relations to the surrounding formations. In many cases a knowledge of the fossil organic remains of the formation is of still greater importance than a knowledge of its Mineral characters. One of the more prominent examples of this kind, which occurs to me at this time, is that of the great lead-bearing formation of the States of Wisconsin, Illinois, and Iowa. For many years a serious misapprehension existed in regard to the true position of the lead-bearing rock; and only so lately as 1850, was it determined, by a proper examination of its organic remains, that instead of being in the Niagara group, as formerly supposed, it belongs to a much lower series of rocks, viz: a Lower Silurian Limestone. This erroneous impression gave rise to fruitless searches for Lead ore in the Niagara limestone, which this late information will discourage. There are at this time multitudes of practical miners who know at once, by the occurrence of certain Fossils, the presence of the Lead-bearing rock, and who would never think of searching for Lead ore in any rock where these Fossils do not exist. This is perhaps one of the most striking instances that can be mentioned, though it is by no means an isolated one; since all Economical products of the

Fossiliferous rocks can be traced in the same manner. Miners of coal and of other products recognize the surrounding Strata, and determine their proximity to the productive bed, by the presence of certain fossils well known to them at sight.

36 Do you consider from your knowledge of the Geological structure of Canada that we shall be rich in Mineral products ?—*Ans.* From a knowledge of the great Geological features of Canada, derived chiefly from the Reports of Mr. Logan, as well as from some cursory observations of my own, I infer that the Country is rich in all those Mineral products (with the exception probably of coal,) which lie at the foundation of modern progress and civilization. Without enumeration, I need only refer to the list of Economic Materials given in the Geological Report, of 1849-50, and to the display of mineral products in the Canadian department of the Grand Industrial Exhibition of London in 1851. I might mention, however, the immense area of the Geological formation composing the Laurentine mountains on the north of the St. Lawrence, having a length of one thousand miles by a breadth of one hundred miles, in which occur deposits of magnetic Iron ore the most extensive and valuable in the known world. This Ore, so famous in Sweden for the manufacture of steel, is associated in the same formation with specular Iron ore, Galena, Plumbago, indications of Corundum, and other mineral products. Succeeding this, you have a large area of Copper bearing rocks of the Lake Superior region, in which both Copper and Silver occur. You have also some forty or fifty thousand square miles of country on the south of the St. Lawrence composed of Metamorphic rocks of a later age. Ten thousand square miles of this area have been shown to contain Gold, and the entire formation abounds in Magnetic and Specular Iron ores, Chromic iron, Copper ore, Serpentine, Marble, Soapstone, Roofing slates, and many other economic products. In the other formations comprising half the entire area of Canada, are abundance of Limestones and other building stones, Clays, Ochres, Bog iron ores, Asphalt, Gypsum, &c., &c.

37. How do we stand in this respect as compared with the neighbouring States? —*Ans.* In this respect Canada stands before any one of the United States, except those containing coal ; but taking all the States upon her borders together, the comparison in every thing except coal is very nearly equal, if we compare equal areas of country.

38. Has Phosphate of lime been advantageously used in the States for agricultural purposes ?—*Ans.* Phosphate of lime has been advantageously used in some parts of the United States for agricultural purposes, and its use is increasing. A vein of this Mineral, of an impure description was discovered in the northern part of New-York during the Geological survey ; and it has since been used to a considerable extent, and one or more cargoes of it have been shipped to Europe, though it was ultinately found to contain too little of the Phosphate to be worth the expense of transportation.

39. Is there any such difference in the Geological features of America and Europe as to raise any doubt whether persons, practically acquainted with the latter only, would be safe guides on this Continent ?—*Ans.* There are differences of great importance in the Geological features of America and Europe, but not such as would preclude those *practically* acquainted with the latter from being safe guides in the former. It would be far more likely that those persons who are *theoretically* acquainted only with European geology, and with little or no practical knowledge of the same, would prove unsafe guides on this Continent. The means of ascertaining the general Geological features of this Continent from published works, leave no excuse, except from incapacity, for not understanding the important differences of the two countries. I should say however that any well informed and judicious European Geologist, coming to this country for scientific purposes, would immediately avail

himself of the means of becoming acquainted with American geology. One thing however is certain, that no European geologist could come to this country, and publish results of his examinations of our Mineral products and our Geology, without being correctly appreciated by the native Geologists, both in regard to his knowledge of American geology and his knowledge of Geology in general.

40. Are you aware whether any preparations have been made in the State of New York or in other States, to collect Geological specimens for the Paris Exhibition?—*Ans.* No preparation has been made in New York, nor, so far as I am aware, in any of the states by authority of their respective governments, to collect Geological or Mineral specimens for the Exhibition in Paris for 1855.

41. Do you consider that a good collection of this kind sent from Canada would operate advantageously for this Province?—*Ans.* I am decidedly of opinion that a proper collection of this kind sent from Canada would be of essential service in making known to Europeans the Mineral resources of the country. Such a collection would attract more attention there, and the results would be more positive and immediate, than would follow any other mode of presenting this information. It is certainly surprising, that States like New York, New Jersey and Pennsylvania, and others, possessing immense Mineral resources, should not have taken means to procure a collection of Mineral productions, to be sent to Paris under the superintendence of some competent Geologist, or Mineralogist, who could at the same time give reliable information relating to the mode of occurrence and Geological position of these materials.

42. Do you think such a collection would be valued in France if presented to any of the Public Institutions?—*Ans.* I am certain that such a collection would be highly valued in France; and if placed in the School of Mines, or any other Institution of learning, would be made the basis of teaching the Geological structure and resources of Canada, and would receive especial attention in their course of instruction. I might in this connexion mention that there does not exist in the United States any considerable collection showing the Mineral resources of any one of the States arranged with reference to its Economic relations; or a Museum of Economic Geology, or a collection adapted to the teaching of Metallurgy and Mining, such as Mr. Logan is endeavouring to establish in Canada. It is to be hoped that such a great necessity will soon be supplied through the liberality of some of our State Governments. In the meantime every lover of Science, and every one desirous for the advancement of his country, should feel proud of the advances in this direction made by Canada, and more proud of the liberal feeling which still prompts to the continuance and perfection of a work so well begun.

[Witness withdrew.]

Adjourned till 11 o'clock, A. M., To-morrow.

UNIVERSITY
LIBRARY
BRITISH

Committee met. *Thursday*, 12th October, 1854.

MEMBERS PRESENT.

JOHN LANGTON, Esquire, in the Chair.

MR. BELL,
MR. TACHE,
MR. FERGUSON,
MR. VALOIS, AND
MR. RHODES.

Professor *E. J. Chapman* of the University College, Toronto, Examined :—

43. Are you Professor of Geology and Mineralogy in "University College," Toronto?—*Ans.* I am.

44. Have you ever been practically engaged in any Geological Surveys?—*Ans.* Yes, in several: principally for Railway and Water Companies. I have also taken part in Mining surveys ; and I may mention, as lending more weight to my evidence on this occasion, that I am the author of several works on Mineralogy, and of a considerable number of published papers on Mineralogy, Mineral Chemistry, and Geology, many of which have been translated into foreign scientific Journals. For three years, likewise, I was a Professor in University College London.

45. Are you in any way acquainted with the Geological Survey going on in the United Kingdom?—*Ans.* I am well acquainted with most of its details ; Professor Ramsay, who, under Sir Henry de la Beche, is Director of this survey, was a colleague of mine in University College London.

46. In what manner do they proceed?—*Ans.* They go over the ground with the assistance of the maps of the Ordnance survey, and lay down the results of their observations on these maps. The Geological survey maps are thus nothing more than the Ordnance survey maps coloured geologically. The Ordnance maps are upon the scale of an inch to the mile, shewing every stream and bye-road, every barn indeed, with the greatest accuracy. The Geological surveyors therefore, have not to attend in any way to Topographical details ; an advantage not possessed by the Surveyors in this Province. Besides maps, the Geological survey of Great Britain issues colored sections, to show the positions of the rocks beneath the surface, plates and descriptions of fossils and other publications.

47. Have you had an opportunity of ascertaining the progress that has been made in the geological survey of this Province ; and what is your opinion of that progress?—*Ans.* I have devoted several days to a very careful examination of the work already performed, and the materials collected under Mr. Logan's direction ; and I can only express my wonder that so much should have been done ; considering more especially the small means hitherto at Mr. Logan's disposal, the want of Topographical maps, and other difficulties incidental to a new country.

48. What, in your opinion, would be the best manner of placing the information and materials already collected on the Provincial survey before the public?—*Ans.* I would propose five things, with this view :—First, the publication of a Geological map of the Province on a convenient scale for general reference, accompanied by a short Pamphlet descriptive of the run of the various formations &c., with a list of the Economic products peculiar to each of these. Secondly, the publication, from time to time, of detailed maps of portions of the Province on a larger scale,

wherever the Geological features of the district may render this advisable. Thirdly, the re-issuing in a condensed and revised form, of the reports already published. Fourthly, the publication at convenient intervals—say at the rate of about one in the year—of a series af nine or ten plates of new or highly characteristic fossils brought to light by the Survey, with descriptive letterpress. And lastly, the effectual establishment of a Museum open to the public on stated days; devoting one portion of this Museum, according to Mr. Logan's present arrangements, entirely to Economic materials with practical illustrations of the uses to which they may be applied, so far at least as this can be effected; and a second portion to a collection of Fossils, Minerals, &c., exhibiting the practice and science of the survey, (see Mr. Logan's report for 1852 page 54 *et seq.*)

49. Would the publication of the results of the Canada survey be of special utility to you in imparting to your Pupils a correct knowledge of the Mineral resources of the Province?—*Ans.* It would greatly assist me in doing so, and be of the most essential service to my classes. I have much felt the want of a convenient Map; several of Mr. Logan's valuable reports, moreover, are out of print, and I have been quite unable to obtain copies of them.

50. In what manner would you recommend that the Revised Reports should be published, and what system of distribution would you recommend?—*Ans.* I should recommend the re-publication of these Reports in the form of a single volume of convenient size, in which the Economic portion should be kept, as far as possible, distinct from the other parts. I would suggest that a large number, from 10,000 to 20,000 copies at least, should be struck off, and sold at a price not more than sufficient to cover the cost of distribution. A certain number might also be distributed gratuitously among the Schools, Mechanics' Institutes, and other similar establishments throughout the Province; copies should also be sent to Public Libraries, &c., in the United States and Europe.

51. What would be the probable expense of such publication?—*Ans.* On this point I am not, perhaps, a very good authority. I should judge that the cost for paper, printing, and binding of twenty thousand copies would be about two thousand pounds; but an estimate might readily be obtained from any printer.

52. What annual appropriation do you think would be sufficient to publish the Plates and Illustrations, what number would you recommend, and how would you distribute them?—*Ans.* On these points I can only speak generally. I have calculated with Mr. Hall and Mr. Logan that about five hundred pounds would pay for the designing and engraving figures for ten plates, the printing of two thousand copies of these, for an equal number of copies of letter-press, and for the services of a Palæontologist in drawing up the descriptions of the plates and figures. A certain number of copies should be reserved for presentation to public Libraries and colleges throughout the Province; others should be presented to similar Institutions in the United States and Europe: and the remainder might be sold at a moderate price per copy. This estimate does not, of course, include the publication of maps. A similar sum per annum would probably be required for this latter purpose.

53. Do you not think that it is very important that increased assistance should be given to Mr. Logan in the Topographical department, in arranging the Museum and in office-work generally, so that more of his time might be devoted to Scientific inquiries?—*Ans.* I think so, most assuredly. There is ample work for several Topographical surveyors;—and additional assistance will certainly be required for the Museum, if a sufficient grant be allotted to Mr. Logan to enable him to put it in to working order.

54. The results to be expected from a Geological Survey being two-fold ; the establishment of new Scientific truths, and the discovery of facts and materials of Economic application, can you state to the Committee some of the advantages in both of these branches, which have been already derived from the Survey, and may be expected from its future extension ?—*Ans.* With regard to Economic discoveries, I may state generally, that the Survey has brought to light the existence of beds of workable Peat, before, I believe, unknown in Canada, or at least undescribed ; of Slate of excellent quality, of Limestone bands, where Limestone was supposed to be absent, and of Lithographic stone, Serpentine, Soapstone, White brick clay, and other valuable materials, previously altogether unknown or undiscovered, along the localities indicated by the Survey ; it should also be remembered in an inquiry of this kind, that *positive* discoveries are not the only facts of importance to be made known, *negative* results being in many instances almost equally valuable. Of this latter class, the proof of the non-existence of Coal over the greater part if not the whole of Canada, is entirely due to the Survey ; whose labours have thus put a stop to much useless expenditure of money in futile researches after that mineral. Looking at the Survey again, in a Scientific point of view, we find it elaborating many facts of the highest interest, some of which, I do not hesitate to say, may take rank with anything made known of late years by European Science. The discovery of Phosphate of Lime as the chief component of certain shells, is a striking case in point. It was long considered as a settled fact that the Chemical composition of the bones and teeth of vertebrated animals differed entirely from that of the shells and hard parts of the lower classes of the animal kingdom : consisting in the former essentially of phosphate, and in the latter, of carbonate of lime. This fancied difference has been broken down so far as regards certain brachiopods, by the chemical researches of the survey ; a discovery which will, no doubt lead to important deductions. Another very interesting discovery is that of the crustacean tracks on the Potsdam sandstone. The celebrated discussion, to which this has given rise in England, has attracted the attention of scientific men, all over Europe, to the results of the survey. Several new minerals have likewise been discovered, and errors have been rectified in regard to species long known. A great deal of light has also been thrown on the complicated question of the metamorphism of rocks, and from the investigations now being carried on, both by Mr. Logan and Mr. Hunt, much more may be shortly expected. There can be no doubt also, that when the complete investigation of our Canadian rocks is accomplished, so far as to justify minute comparison with rocks of the same age in the United States and Europe, many important generalizations will be arrived at, leading in the end to a revised grouping and nomenclature. Finally, it should be borne in mind, that the chief attention of the survey has been hitherto bestowed on economic questions, the scientific investigation of the geology of the Province having been made in a great degree subservient to these. As the survey progresses therefore, its science will be necessarily more fully developed.

55. Can you give instances from your own experience in such surveys of the practical importance of results which at first sight might appear to be exclusively of scientific interest ? *Ans.* Many instances of this kind are well known to Geologists; some have come under my own observation ; when a railway crosses a stream in England, the law compels the Company to make the waterway sufficiently large to prevent the land around from being flooded during times of heavy rain, or from the melting of the snow. It is very frequently inconvenient to the Engineer to make the waterways larger than is absolutely necessary ; and the usual method of procedure is to measure the nearest existing waterways, ascertaining at the same time from persons living near the spot, if these be of sufficient size to admit at all times the flow of water through them. When engaged some years ago in this kind of work, I was surprised to find the waterways over a small stream quite insufficient to prevent flooding, when from another stream in the same

locality with smaller waterways, no flooding took place ; the physical aspect of the country exhibiting no cause for the difference in question, but rather tending the other way. On examining the district geologically, however, the problem was explained at once. The hills and higher ground along the one stream were capped with stiff impermeable clay ; along the other, with gravel. All the rain which fell upon the clay, apart from that taken up by vegetation, ran off into the stream ; whilst the greater part of the rainfall upon the gravel was absorbed by the porous nature of the soil. Now had a Geological survey of such a district been made before the erection of bridges, it would have shewn that the waterways over the one stream must have been very much larger than those over the other, if flooding were to be avoided.

Another case, much of the same kind, came under my notice more lately. Whilst prosecuting some Geological inquiries in Hertfordshire. A miller inquired of me why the stream on which his mill was situated, after having been at one time sufficient to drive eight pairs of stones, had gradually become unable to drive more than three pairs ; thus greatly deteriorating the value of his property. The surrounding country was clay overlying porous chalk. On examining into the matter, I found that an extended system of drainage by means of the so-called "dumb wells" had come into operation in the district during the preceding three or four years, and had thus gradually affected the water power of the stream. These dumb wells are pits dug through the clay into the absorbent chalk, and afterwards filled up with rounded stones or other matters admitting the free passage of water. Drains being led into these, the greater part of the rain-fall is carried into them, and so down into the underlying porous rock. Whenever therefore a Geological investigation of a district points out the existence of permeable beds lying at an accessible depth beneath stiff clay lands, and good surface drainage is not readily obtainable, recourse may be had to the method just described.

The study of organic remains, again, is sometimes thought by persons unacquainted with the whole bearings of the question, to have little or no connexion with the practical applications of Geology ; but this is altogether an erroneous conclusion. Fossils or organic remains have a two-fold value ; first, in revealing to us the history of past creations, and many of the physical changes which our Planet has gone through ; and, secondly, in enabling us to determine the relative positions of rock groups ; each group, within certain limits, holding its own peculiar forms. Now it is well known that certain economic products are confined over wide areas, either wholly or principally, to certain rocks. To fix the exact positions of these rocks therefore in the entire series of strata, becomes a problem of the highest importance, and one, it may be safely affirmed, that in nine cases out of ten, can only be solved by the study of organic remains. In North America, for instance, we have many bands of rock streatching far and wide across the continent. One of these is remarkable for its richness in brine springs and gypsum beds ; and by the fossil forms in the bands above and below this, it can be ascertained at points far distant from one another, if we be above or below, near to or distant from, the salt and gypsum yielding rock ; whereas if mineral characters alone were attended to, no reliance could be put on any decisions of the kind. In like manner, the position of the Mountain limestone so rich in many countries in veins of lead ore, of the coal-bearing rocks, again, and of all the other rocks in the series, however closely resembling one another in structure and mineral composition, can be determined with perfect confidence if sufficient Palæontological data be afforded. We thus see that a study apparently only of scientific value, and one worked out in the first instance by scientific researches, has become of the highest importance in a purely practical point of view. In England, as in all other countries indeed, many striking examples

may be found of what the study of organic remains has effected for practical science. In rocks far beneath the coal measures, as well as in others far above them, I have seen old shafts, for instance, which must have swallowed up thousands of pounds, still remaining as memorials of futile researches after coal, before Geology was prosecuted as a science.

56. Do you think it would be advantageous to this Province to send a geological collection to the Paris Exhibition?—*Ans.* I think it most desirable that a collection of this kind should be sent. Anything, serving to attract the attention of the scientific and commercial world towards Canada, must necessarily be beneficial to the Province; and I know of no course more likely to win that attention, than the one proposed.

57. You think then, that we have the means of forming a collection, which would be looked upon as valuable in Europe?—*Ans.* There can be no doubt about it The interest excited by the collection sent to the London Industrial Exhibition affords most ample proof. I would suggest the expediency of placing the collection entirely under Mr. Logan's charge; Mr. Logan's name being, I know, as much respected in French scientific circles, as in those of London. A collection left to shift for itself, or placed in inefficient hands, would, I am quite sure, be deprived of more than half its value as a means of awakening attention towards the Province, and shewing its mineral resources.

58. Do you think that any advantages would arise, by the Provincial Geologist being in communication with private individuals in different parts of the Province, who take an interest in the science; and can you suggest the best means of establishing such a general intercourse? *Ans.* Mr. Logan is, I believe, already more or less acquainted with every Geological Amateur in the Province, and always ready to receive and publicly acknowledge any information relating to rocks and their contents. He has also printed in one of his Reports a series of questions concerning these matters, adapted to the understanding of working men, and addressed to all the Province. These questions—shewing what to look for in any locality—might perhaps be advantageously re-printed in prominent type on the covers of the publications to be henceforward issued. In the course of a few years, likewise, as Geology becomes more cultivated in the Province, an annual gathering of all interested in the science, might be brought about at Montreal or, wherever the Museum were situated. At these meetings, papers might be read, and discussions entered into. The time, however, I think has scarcely yet arrived, for a plan of this kind to be adopted with success.

59. Have you any other suggestions to make to the Committee on the subject of the survey? *Ans.* I believe that my remarks, in answer to the questions already put to me, comprise all that I have to say upon the subject. I would beg leave, however, again to express my sense of the utility of the Survey, in regard both to its future progress, and to what it has already accomplished. Looking, for example to Great Britain, and to France also,—countries in which the study of Geology is so much cultivated—we find although numerous Geological investigations had been carried on by private individuals and companies long prior to the organisation of the Government Surveys, yet, that these latter have made known many important applications of the Science to practical purposes, and shewn the existence of economic materials previously undetected. In a new Country like this, therefore, we may legitimately expect that many Scientific and practical developments of no ordinary value will result, from an efficient continuation of the present work.

[Witness withdrew.]

Ordered,—That Mr. Russell, of the Crown Land Department, be summoned for To-morrow.

Adjourned till 11 o'clock To-morrow.

Friday, 13th October, 1854.

Committee met.

Members present.

JOHN LANGTON, Esquire, in the Chair.

MR. BELL,
MR. TACHE,
MR. FERGUSSON,
MR. VALOIS, and
MR. RHODES.

Alex. Russell, Esquire, of Quebec, examined :—

60. You are in the Crown Lands Department ?—*Ans.* I am Senior Surveyor and Draughtsman for Upper Canada.

61. Are you acquainted with the maps which Mr. Logan has made in connection with the Geological Survey ?—*Ans.* I am well acquainted with them. Mr. Logan lent them to the Department, and we made copies of them.

62. Have they been of much use?—*Ans.* The Department has derived great advantage from these maps, not only in my own branch but also in the timber branch. In the unsurveyed parts of the Province they are often the only reliable information we have, and in the surveyed townships they frequently point out what errors exist. Errors are very numerous in the old Surveys, in consequence of the work having been done in a hurried manner, and also from local attraction, as the magnetic bearing was the only means used in these Surveys.

63. Have any of these errors been in consequence corrected ?—It is not allowable by law to alter any original survey, performed under the authority of the Government, even if errors are detected in it ; but it is very important to know what they are, and much benifit has been derived from Mr. Logan's maps in this respect.

64. Can you point out any other beneficial result from the Geological Survey ?—*Ans.* In addition to the important topographical details contained in Mr. Logan's maps, which are of essential service in the organization of the waste lands of the Crown, forming, indeed, the basis for the projection of their subdivision into townships and farm lots, his reports convey much valuable information respecting the agricultural capabilities of the country, its timber, economic materials and water powers, aiding the Government greatly in deciding where new surveys should be made, and guiding the intending settler to the most favorable localities for farming, lumbering or mining. Mr. Logan's thorough practical knowledge of economical geology and mineralogy enables him to develope the resources of the country in a manner and to an extent which none of our provincial land surveyors can,—for instance,—his examinations and reports on the mineral regions on Lakes Huron and Superior, by which the Department was guided in granting the mining locations. I would also beg leave to refer to the great benefit the province derived from Mr. Logan's laborious exertions in making so extensive a collection of Canadian minerals for the Great Exhibition at London, and to his valuable services there, in bringing them under the notice of the capitalists and manufacturers of Europe, which his high standing among geologists, enabled him to do most effectually.

65. What is you opinion of the accuracy of Mr. Logan's topographical surveys?—*Ans.* Mr. Logan made a survey of the River Mattawan, a tributary of the Ottawa, and afterwards a regular survey of the same district was made by order of the Department. The two surveys differed by about two chains only in a distance of thirty eight miles,—and in his survey from the St. Lawrence to the Bay of Chaleurs, by the Chat and Cascapedia Rivers, a total distance of a hundred and eleven miles, the difference between his measurements and that ascertained by the latitudes and longitudes of the extreme points, determined by Captain Bayfield, was less than a quarter of a mile. From these instances I entertain a high opinion of Mr. Logan's accuracy as a topographical surveyor.

[Witness withdrew.]

Adjourned till 11 o'clock, To-morrow.

W. E. Logan, Esquire, of Montreal, examined :—

66. How long is it since you commenced the Canadian geological survey?—*Ans.* I was applied to in the spring of 1842, by Lord Stanley, then Secretary of state for the Colonies, to know whether I would undertake a geological survey of the Province, and having agreed to do so, I came out and spent about four months in making a preliminary examination, in order to arrange a plan of work. Unfulfilled professional engagements required my presence in England, and I went back in December. For this preliminary work no charge was made to the Government; and the survey may therefore be said to have commenced when I returned to America on the 1st May 1843, or upwards of eleven years ago.

67. Can you give a short statement of what you have done up to this time?—*Ans.* It will be observed by a reference to the Reports of Geological Progress published, that the districts examined are as follows :

The Canadian coast and islands of Lake Superior, and two rivers on the north shore for distances of forty and sixty miles up. Here there has been shewn to exist an important copper region.

The Canadian coast and islands on the north shore of Lake Huron with distances of from twenty to seventy miles up four of its principal tributaries. Along the coast the copper-bearing rocks have been shewn to continue to some distance eastward of Lacloche.

The coast of Lake Huron from the mouth of the Severn round by Matchedash Bay, and Cabots Head to Lake St. Clair; that of Lake Erie from the vicinity of Chatham to the exit, and the upper part of Lake Ontario; with most of the country included in the perimeter formed by these coasts and a line from Toronto to Lake Simcoe. In this have been shewn great ranges of valuable building stone, of gypsum, and hydraulic and common limestone, with extended areas of white and red brick clay, bog iron ore, asphalt and mineral oil; while the structure, proved by the ascertained distribution of the formations, shews that there can be no workable coal beds in a part of the country, where even practised observers, without due caution, would be liable to mistakes that might lead to great loss of capital.

The country in a general line between Lake Simcoe and Kingston along the junction of the fossiliferous and unfossiliferous rocks; in the former of which are shewn the existence of a great range of valuable building stone, as well as hydraulic and common limestone, with lithographic stone; and in the latter enormous deposits of magnetic iron ore with whetstones, plumbago, crystalline lime-

stone and other materials; while the drift displays great areas of white and red brick clays, in some places covered by extensive tracts of excellent peat and shell marl.

The country between the St. Lawrence and the Ottawa, south of a line from the vicinity of Kingston to Pembroke, comprising a surface of about 10,000 square miles, where in addition to great areas of peat and shell marl, and clay fitted for common bricks and pottery, with bog iron ore and ochre, great ranges of building stone, hydraulic and common lime stone, and white sandstone fitted for the purpose of glass making, in the fossiliferous rocks; and magnetic and specular ores of iron, lead ore, some copper ore, plumbago, phosphate of lime, great and extensive beds of crystalline limestone, sometimes giving good marble, barytes and traces of corundum have been found in the unfossiliferous.

The Ottawa from its mouth near Montreal to the head of Lake Temiscamang, a distance of 400 miles, with many of its tributaries on the south bank for distances of from twenty to forty miles up. The economic materials in this are similar to those in the previous area and in equal abundance.

The north side of the St. Lawrence from Montreal to Cape Tourmente, as far back as the junction of the fossiliferous and unfossiliferous rocks, comprising an area of 3000 square miles, in which have been found clay fit for common bricks and pottery in great quantity, accessible in almost every part; bog iron ore in large abundance, a profusion of iron and manganese, ochres of various beautiful tints, tripoli or infusorial earth, refractory sandstone admirably adapted for furnace hearths, white sandstone fit for glass-making, ranges of excellent building stone extending the whole distance, marble, and limestone fit for burning.

The south side of the St. Lawrence and the Eastern Townships from St. Regis to Etchemin River, a surface of about 15,000 square miles, a large portion of which is occupied by a mineral region of great importance, found to hold inexhaustible supplies of roofing slate and of beautifully variegated calcareous, and magnesian marbles, the latter resulting from a band of serpentine which has been traced for 135 miles, soapstone in great abundance, dolomite, magnesite, chromic iron, whetstones, extensive intrusive masses of most beautiful granite, magnetic iron ore, occasional indications of silver-bearing lead ore, copper ore, and gold, while in the less mineralized part are good arenaceous and calcareous building stone, flagstone, white sandstone for glass-making, common brick and pottery clay, bog iron ore, peat, shell marl, and other materials.

The country between the Etchemin River, and Temiscouata portage road, in which many of the same materials as in the previous area will be found, but cannot yet be pointed out in a connected manner, the exploration having been only partial.

The coast of the Gaspé Peninsula from the Metis road by Cape Gaspé and Isle Percée to the mouth of the Matapedia River, a distance of about 800 miles, with several sections across the Peninsula from the St. Lawrence to Bay Chaleurs; the chief object of the exploration of this district was to determine the northern limit of the great eastern coal field of North America, spread out in the sister colonies; and as the carboniferous area lies unconformably on the inferior rocks, to ascertain whether any outlying patches might exist in the Peninsula. None such, however, have yet been discovered.

A large and valuable collection of specimens has been made to illustrate the economic materials, the minerals, rocks and fossils of the districts examined. This is preserved at the office of the Survey; and now that a suitable building has been placed by the Government at the disposal of the Survey, a commencement has been made to a classification and arrangement of the materials into two divisions, one to display the character and application of the useful materials, and the other the science of the whole subject.

The true bearing of geological facts, as parts of a whole, being unintelligible without the exhibition of their relative geographical positions, and so large a portion of Canada being still unsurveyed topographically, it has been necessary to measure accurately extensive lines of exploration, and the maps resulting have proved of great value to the Crown Land Office. From this collateral work is derived a large part of what is known of the interior of the Gaspé Peninsula, where six streams have been measured; the Matane, the Chat, the St. Ann, the St. John, the Bonaventure and Great Cascapedia. It has shewn the courses of the Kamanistiquia and Michipicoten rivers on Lake Superior; of the Thessalon, the Mississague, the Spanish and the French rivers, on Lake Huron; in addition to 150 miles of the Ottawa and the whole length of the Mattawa. From it has resulted the improved delineation of the forms and distribution of a great chain of lakes in the rear of Kingston, and last year the course of the Muscoco from Lake Huron to its source; of the Petewawe from its source to its mouth; of the Bonnechere from its junction with the Ottawa to one of its sources; of the York branch of the Madawaska, with a sketch of the relations of various streams, from the tributary just mentioned to Balsam lake, the whole distance in these explorations and admeasurements being 500 miles.

Chemical analyses have been made of all the metallic ores, and such other useful minerals as required it, the number of which has been very great, and in addition of upwards of fifty valuable mineral springs, of a great collection of soils from both divisions of the Province, and of new mineral species.

68. What means have been placed by the Government at your disposal?—*Ans.* £1500 in the first instance, then £2000 per annum for five years from March 1845; £2000 per annum for five years, from July 1850; and £1000 for fitting up the Museum.

69. Have you found this appropriation sufficient to enable you to proceed as rapidly as you would have desired?—*Ans.* When the survey was proposed to me by the Secretary of State for the Colonies, the sum of £1500 had been voted for the purposes of the inquiry. Though well aware that this would be totally inadequate, having no mercenary object in view, I undertook the task, determined to make the money go as far as possible; and at the end of about two years work, I found the survey upwards of £800 in my debt. I was then asked by the Government for an estimate of what would be required to carry on the examination efficiently. The estimated sum I rendered was £2000 *sterling*, to gradually pay arrears and continue the exploration and chemical analyses; but through inadvertence, the sum introduced into the Act establishing the survey for five years was £2000 *currency*, and at the expiration of these five years the Act was renewed for five years more with the same provision. The result of this substitution of currency for sterling has been, that the chief part of the difference has gradually left my pocket, in carrying into effect exploration and chemical analyses only; and now that so essential an adjunct has been made as a Museum for the illustration of the useful applications, of which the materials collected are capable, and an exhibition of the general science of the subject, without an additional grant, the pressure upon me would probably increase. In the Report of Progress for 1851–2, pages 54 to 56, to which I beg to call the Committee's attention, the expediency of an especial appropriation for this purpose has been alluded to, and the Legislature has sanctioned the application of £1000, for putting the house and rooms of the Museum into a suitable condition; but a part of this being expended upon heating apparatus, precautions against fire and other necessary arrangements, it has been found impossible to carry the interior fittings for the display of specimens quite so far as the materials collected require. Cases for a room to show the applications of geology to agriculture are still wanting, and for the further extension of some of the other branches of the subject. I have been under the necessity of

supplying at my own expense nearly all the scientific books indispensable for the proper prosecution of the survey, (now a respectable nucleus of a scientific library) and all the more costly instruments required both for topographical surveying and chemical analyses. A room has been fitted with cases for the reception of the books; but without additional provision, the funds to defray the cost must come from my Exchequer instead of that of the Government. In connexion with expenditure, I may here state, that a considerable collection of Canadian economic minerals having been made for the London Industrial Exhibition of 1851, I was naturally desirous that it should be placed in the best manner before the public, and requested of the Government leave of absence in order to attend to it on the other side of the Atlantic, offering, provided my salary were not stopped, to defray all my own expenses; for although I felt strong hopes that a favorable impression would be produced by the collection, I was unwilling to put the Province to more expense than I could help before success was achieved. Before the close of the Exhibition I returned to Canada to carry on the work of the survey, and I again went to Britain for a short time the subsequent winter, to make a proper distribution of the materials that could easily be replaced, and to secure and bring back such as could not, or on which some labor had been bestowed, to put them into a useful or attractive form; and my time on both occasions may most emphatically be said to have been devoted to the interests of the survey. Living in the most economical manner, my expenses including passage money amounted to £450, which is about thrice what they would have been for the time in Canada. It is true that I consider this amply repaid by the complete success of the collection, and by the expression of approbation, which I had an opportunity of eliciting from men both of practice and of science, as to the progress that had been made in the survey, and as to the results. The best proofs I can give of this approbation are what was said of the Canada minerals by the Jury of the class to which they belonged, a copy of which I beg to hand to the Committee in the original French, and the honor conferred upon me for this and previous work, in being elected a Fellow of the Royal Society. It may be unknown to many, that only a limited number of members (fifteen I believe) is annually elected, and that the candidates for admission are usually three or four times the amount. Many candidates have been for years before the Society without success. Sir Roderick I. Murchison, than whom no one can be a more eminent judge of what deserves commendation in geological work, proposed me, seconded I believe by Sir H. T. Delabeche, the Director General of the Geological Survey of the United Kingdom, and though my name as a candidate had been before the Society only just about the time absolutely required by their rules, I received the votes of seventeen out of eighteen of the number constituting the Council, to many of whom I was not *personally* known the only candidate who obtained all the votes being Mr. Hind, the astronomer, so well known as the discoverer of many new planets. I esteem the honor the more, as I believe I am the first native Canadian who has been elected a member, or at any rate the first native Canadian who has been elected for work done in Canada. I may thus sincerely say that I feel amply remunerated, but still the expense incurred renders me less capable to meet the deficiencies of the annual appropriation, the amount of which does not enable me to proceed so rapidly as I should have desired.

Perhaps while I am touching on the pressure of the survey on my own means, I may be allowed to say that just after the survey had been established for five years, at the rate of £2000 per annum, an application was made to me on the part of the East India Company, to know whether I would undertake an examination of their territory for coal. This branch of geology is that which I best understand. The field of research was new, and India is a country attracting much more European attention than this. I felt perfectly certain that the investigation would lead to a very extended reputation. The salary offered me was more than double what

I have here; an efficient staff was to be provided with all kinds of those aids which the Indian Government could so readily afford. But influenced by a rooted attachment to this country, and feeling that perhaps some favor had been extended to me by the community in the present investigation because I am a Canadian, I did not accept the offer.

I must not omit to state to the Committee, that while the deficiency of the Legislative provision for the survey presses upon me, the present increased value of all the necessaries of life does so severely on those associated with me in the investigation.

70. What are the principal difficulties you have met with?—*Ans.* The principal difficulties I have encountered, independently of those unavoidably incident to travelling in canoes up shallow rivers, and on foot through the forest, are those arising from the want of a good topographical map of the country. Accurate topography is the foundation of accurate geology. Unless you know the geographical position of every rock exposure that comes before you, you cannot tell the general relations of the whole, and you cannot make the physical structure of a district intelligible to yourself or to others. Without geographical position, the dip and strike of a rock are worth nothing, and the occurrence of a valuable mineral in two localities distant from one another are just two isolated unrelated facts; while their topographical place being known, their dip and strike may immediately point to the probability, and guide to the search and discovery, of the same substance in a hundred places between. It thus becomes necessary in unsurveyed parts of the country to measure correctly, as I have already stated, long lines of exploration. But even in those parts which are settled, neighbouring townships having been surveyed separately and independently, and often not very correctly, it is next to impossible in putting them together to get them to fit. Lots, or portions of lots, that are in juxta position on the old maps given in to the Crown Land Office, are not so in the field; and in many of the old surveys, lines in one and the same township, such as the township of Grenville for example, and others in the same neighbourhood, lines that on the paper are represented as straight, go staggering through the bush in zig-zags that would surprise an Indian hunter. In laying down work on such maps as these, it will be immediately seen, that if you have a useful mineral in two distant localities, such a mineral, for example, as serpentine, soapstone, slate, or such like, between which localities the observed structure of the country tells you the mineral mass should run in a straight line, and you should draw such a line from the one to the other on your paper, you might represent the mineral as occurring in lots where it was absent, and leave it out of those where it was present. Or supposing you followed the bed along its strike or direction from point to point, and then placed it on the lots in which it occurred, the result would be, that the course of your mineral would appear to have a multitude of what in this country are termed *jogs*. The geological inference to be drawn from the appearance of such on your paper would be, that the mineral band you were representing had been broken or dislocated by what are termed *faults*. The general bearing of your band would be incorrect, and might mislead you if you were depending on your result for further search; and if a map were published with these jogs, it would deceive geologists and mineral surveyors at a distance in respect to the general condition of the country's structure, making them think it was a disturbed one, and proper for the search of metalliferous veins, when it might have no such veins in it. Such a map would be more deceiving than one, on which the railroads should be laid down on the right lots in the old Crown Land plans of which I speak. No one would be deceived by the jogs in such a case, for the very nature and object of a railroad would proclaim to every one, that it could not have been so located unless the engineer had been insane. The incorrectness of some of the topographical plans, and the fact that we do not know which are right and which are wrong, makes it necessary for us even in surveyed parts, to count and register our paces

over every road and line we go, taking the bearings by prismatic compass, and registering in its proper place every rock seen, with its dip and strike, and a short description of its character, and its economic and fossil contents, if it have any. If the measurement is on a road, a note is made of the position where it crosses lot or concession lines, where it is coincident with or divergent from them; a surveyor's post is hailed by us as land is by a mariner; it represents a fixed point on the map, and enables us to limit our errors, or to detect those of the surveyor, and gives us a fresh starting point. When discrepancies are small, we give the credit of accuracy to the surveyor; but it often happens that no difference of short and long in the paces is sufficient to account for them, and the township plan is found wrong. Working in this way, Mr. Richardson, an excellent and most diligent explorer, last year paced 1000 miles in the Ottawa country, between Pembroke and Vaudreuil, keeping a register of every step; and by means of this pedestrian measurement, and township plans, he has been able to complete a map of the whole area on the scale of an inch to a mile, in which many discrepancies in neighbouring townships have been reconciled, and on which is placed, with sufficient accuracy, every rock exposure he saw. There is a part of the area, however, in and about Hawkesbury, which defies this mode of proceeding, and would require a more accurate species of measurement to set it right. It will be easily understood, that this geographical work must unavoidably impede the rapidity of geological examination; and the necessity of so much measurement to fix the position of rock exposures, forces us, in order to make even a moderate progress, to examine fewer of them, or to give to each a shorter time than we would like, and thus, perhaps, to overlook some of its characteristics.

As Professor Chapman has informed you, the corps employed by the Government in the United Kingdom, to work out the geology of the British Isles, are spared all such geographical measurements. The Ordnance topographical maps, on which they lay down the geology, represent all the natural and artificial features of the country with such minute detail and accuracy, that let them find a rock exposure where you will, they never have to measure over a few yards to fix it; indeed, it is often represented on the map, and they have then only to give it its conventional color. I beg to exhibit to the Committee a couple of the sheets of the Government geological survey of the United Kingdom; they represent a part of the coal field of South Wales, on which it will be perceived that almost every coal seam is laid down in all its windings from undulations, and almost every dislocation or fault, cutting the measures transversely. A knowledge of the position of these faults, or troubles as they are called in some parts of Great Britain, from the manner in which they perplex the collier, is a matter of vast importance in the economics of coal working. Accompanying the surface maps are five vertical sections, on the scale of six inches to a mile, shewing the manner in which the coal seams lie over one another and undulate across the coal field, one of them to the depth of six hundred fathoms below high water mark; and several columnar sections on the scale of forty feet to an inch, shewing the coal seams in their proportional thicknesses and proportional distances above one another, with a detail by symbols and description of all the ground, —sandstone, shale, iron ore and fire-clay-between them; one of the columns exhibits the details of 8,250 feet in succession. Although this and part of two adjoining sheets, which I have not here, are my own work (adopted, after careful verification, without the change of a line, by the government survey of the United Kingdom,) I would not have the Committee for a moment suppose that such work can be done in this country for a century to come. This work represents the details of a coal field, and a large portion of what is shewn on the surface is ascertained from under ground workings; from the accumulation of the drift over the coal crops, they could not in many cases be otherwise ascertained and shewn. The profusion of facts which can therefore

be accumulated by a patient investigator in a coal field, in which there have been extended crop excavations, renders it possible, if only the necessary pains and trouble be taken, to represent an amount of detail that must not be expected in other portions of the map. Independent of this, the present condition of the surface of Canada, and of its topography, would render it impossible to give the geology of the country with the detail of even that part of the British Isles, where there is no coal. Though the portion of the South Wales coal field, contributed by me to the British geological survey, does not exceed four hundred or five hundred square miles, it employed all the time I could spare from other occupations for seven years to put it together. As the reward of my patient labor, I have the gratification of knowing, that it has produced the model on which all the coal fields, that have been examined on the British survey, have been mapped; and although in 1851, thirteen years had elapsed since I presented the work, and other works of a similar character had been performed subsequently, I had the further gratification of hearing Professor Ramsay, who directs the survey of Great Britain, the most skilful field geologist known, say of my performance that it was unrivalled in its time, and had not been surpassed since. It is not through vanity that I state this, for the character of the work is well known on the other side of the Atlantic, but because on an occasion like the present, it is not improper to state what may in some degree be considered a part of the history of geology; and because I conceive it cannot be disagreeable for Canadians to know, that a Canadian geologist has executed a small portion of the best work of the British survey. The character of the work will be seen in what has been said of it in a correspondence between the Colonial Office and various eminent geologists, on the occasion of my appointment to the Canada Survey, the existence of which correspondence I ascertained only after I came to this Country, and a copy of which I have handed to the Chairman.

71. Are you acquainted with the map now being prepared by Mr. Bouchette, and do you think such a map would be of great use to you?—*Ans.* I have seen all the parts of the topographical map in the course of being constructed by Mr. Bouchette. It is a very beautiful map on the scale of six miles to an inch, and it is intended to comprehend both sections of the Province. In the part compiled it represents every lot in the townships, but not those in the seigniories. Its value of course will depend on its accuracy. Mr. Bouchette has been so good as to allow me to employ a draughtsman to copy a part of it for the purposes of the geological survey, with the understanding of course that it is not in any way to be published. I have not yet had an opportunity of placing any work on it, but I can see that in the Eastern Townships several of the errors in previous maps have been corrected. That part which represents Gaspé is largely made up of topographical results, ascertained on the geological explorations of Mr. Murray and myself, of which, in whatever part of the Province they may be, Mr. Bouchette and others have been freely admitted to avail themselves. As it is a compilation, it would be too much to expect that it is correct in all particulars, but from Mr. Bouchette's opportunities it ought to be a great improvement upon former maps, and a good foundation for still further corrections. It is only by each map, that comes out in succession before the public, exhausting a portion of previous errors, that a really good one will be obtained at last. It is to be regretted that Mr. Bochette's map is on too small a scale to give the lots in the Seigniories. I have also seen in progress a map by Mr. Divine on the scale of four miles to an inch; this is of Upper Canada. This scale would be better suited for my purpose, and I do not think it would be too large, if the whole Province were represented on that scale in the form of an atlas. Perhaps I may be permitted to say that the law, which obliges the applicants for railroads to exhibit on a map correctly the boundaries of the various properties the road is to pass through, will afford the means of collecting a great amount of information, that may be made available in

reconciling the discrepancies of neighbouring townships, which have been separately surveyed, and fitting them together If a competent person were employed for the purpose of reducing the railroad plans to a uniform scale, and carrying out the corrections they suggest, it might produce a very valuable result.

72. What additional assistance would you desire to relieve you from the labor of topographical surveying?—*Ans.* It appears to me that two topographical surveyors, one for Lower and one for Upper Canada, yet not necessarily confined to work each in one of the divisions only, would be such as the circumstances of the case require; these should be young men, who can stand hard work, and would consider reputation a part of their reward. As their topography would have a geological object, it would be necessary for them to gradually acquire a knowledge of geology, for which they would have ample opportunity; and I am persuaded this would vastly help them afterwards, in their professional career. As they acquire the necessary knowledge, they might be employed to make geological examinations if necessary. Of course the topographers would require temporary assistance in the field from chain bearers, canoe men and such like.

73. Much of your time must necessarily be taken up with office work and in arranging the Museum; would you be materially relieved by additional assistance in this department?—*Ans.* Each one on the survey has so much to do connected with his own individual department, that all the general office work falls upon me. I keep all the accounts, and for that purpose a set of books by double entry, in which I enter no gross sums, with a reference to accounts, but everything in detail for easy and immediate reference if required, and I render an account to the Government with the same detail on the face of it; so that any one, who chooses, either publicly or privately, to look at the account, can see at once how every penny has been spent. I used at first to make, with my own hands, four manuscript copies of the annual Report of Progress, often reaching more than one hundred printed pages—one copy for the Government, one for the House of Assembly, one for the Legislative Council and one for the printer; but of late I have been forced to employ an amanuensis for part. The fittings of the Museum are scarcely yet completed; when they are I *must* employ additional aid, if it should cost me my whole salary. The accumulated materials of eleven years are to be classified and arranged.

74. What staff altogether would you think sufficient to put the survey upon the most efficient footing?—*Ans.* The present staff consists of five persons,—a directing and an assistant Geologist, a Chemist and Mineralogist, an Explorer and a Messenger. Taking all things into consideration, it appears to me that, to place the survey upon such an efficient footing as the Province could well afford, it would be necessary to add the two Topographers that have been mentioned, and the temporary aid they would require; to have an assistant in the museum, and the occasional services of an accountant, and two or three additional explorers, such as Mr. Ricardson already mentioned, with the temporary employment of miners to obtain by blasting specimens of economic materials, and of artizans to put them into useful forms. Mr. Richardson, before he came to me, had been a farmer and a village schoolmaster. His pay was at first £6 a month, but he gradually became so useful that it was augmented to £10, and in consequence of the late increased price in all the necessaries of life, I shall consider it just to augment it still further. He can construct a very good map of what he surveys, as that of the Ottawa country, between Pembroke and Vandreuil, to which allusion has already been made, and which I now beg to submit to the inspection of the Committee, will testify. Although he may not know by name all the fossils that mark our rocks, he recognizes with facility the most characteristic forms, and knows the formations they belong to; and availing himself of their value in determining the equivalency of exposures distant from one

another, he can follow out our deposits with considerable precision, shew their geographical distribution, and determine their thickness. He is well acquainted with all the useful minerals the various formations hold; he is most careful in registering the localities in which he finds them, and I can place implicit reliance on his fidelity. A considerable part of the useful materials, in the last published Report of Progress on the north side of the St. Lawrence, was ascertained by him; he collected a large part of the economic minerals contributed by the Survey to the London Exhibition, and he is now employed in making a similar collection, as far as the season will allow, for Paris. It is an additional number of such men that would be required in the geological branch of the survey at present. A good mason, stonecutter, slater, miner, or any artizan connected with the working of minerals, having plain common sense and strict fidelity, with just such an amount of education as would enable him to register in a memorandum book the facts that might come before him, by attention to a few geological rules, which of course would have to be taught him, would soon become an explorer of value.

75. What would be the total annual cost of such an establishment?—*Ans.* Exclusive of all publication, the annual cost would be not less than £4000.

76. Do you think any material advantage might be drived from voluntary assistants?—*Ans.* There can be no doubt of it. In localities, in their own neighbourhood, I have received valuable information from various persons, to whom I have been careful on all occasions to render public thanks. Among others who have thus favored me are Mr. Abraham, Dr. Wilson, the Rev. Mr. Bell, Mr. Billings and Mr. Sheriff Dickson. An excellent vein of geological knowledge seems to run up the Ottawa.

77. Do you think that you might derive much aid even from persons who are not strictly scientific men?—*Ans.* I am scarcely ever a day in the field in the settled parts of the country without getting a considerable amount of information from farmers and common labourers, particularly among such as are not haunted by the notion, that all our researches have the precious metals for their object. By a reference to the Report of Geological Progress presented to the Legislature this session, it will be perceived at page 142 how this immediately freezes up the fountains of communication. The settlers on the Ottawa, it appears to me, have got beyond the chance of such an epidemic, perhaps through the influence of some of the gentlemen I have named, and the *Ottawa Citizen*, which occasionally gives them a good sound geological leader. I have been informed, however, that when my friend Dr Wilson first began his mineralogical researches, and used to carry home large blocks of stone to his premises, some of his neighbours imagined that, if he were not searching for gold, no other motive could reasonably justify his proceedings, and he might have suffered severely in parochial estimation, had not one, more sagacious than the rest, explained the matter to his own satisfaction, and that of the community, by announcing that of these stones the doctor made medicine. On the Ottawa more than any where else the settlers have appeared to appreciate what we were about, and have shown a readiness to give information and assistance. Last summer I was engaged in tracing out the crystalline limestone, interstratified with the gneiss of the Laurentian series, in various townships on the north of the Ottawa, from Abercrombie to Grenville. After following a wide band of the rock from the mouth of the Calumet for five or six miles, and explaining as I went the character of the stone to the inhabitants, who in general did not seem to know it, I came to the chantier of Mr. McHardy. He had been a tradesman in Montreal, and having ascertained by experiment that the valley was underlaid by limestone, he was prepared to give me a good deal of information about its distribution. He informed me that this band joined one which

ran irregularly parallel with it, and formed the bottom of another valley to the eastward. This I had traced for several miles, but had not come to the junction, nor had I suspected it. Making search through the bush some days afterwards, in consequence of his information, I found his opinion to be just, and it led me to a better knowledge of the structure of the district, and prepared me for what was to be expected further on. Mr. McHardy had tried what he considered the best part of the stone, because the hardest and least affected by the weather, and although he had made lime from it, it was not of a satisfactory quality, being too sandy. I shewed him that instead of taking the best he had taken the worst stone, the quartz and feldspar in it, which produced what he called the sand, being just the portion which prevented disintegration by the weather. The best stone, I shewed him, was that which fell into grains somewhat like salt, and by means of my acid, that the salt-like granular soil was almost purely calcareous, and I informed him that he had only to dig through this, which would not be very thick, and he would find excellent limestone below. Mr. McHardy informed me of several exposures of the rock between the valleys, and while clambering about a wooded knoll above a road in search of one of them, I was joined by a respectable looking smart old settler, who very civilly, in an accent that let me know at once he was from the north of Scotland, asked me what I was about; on my informing him, and explaining to him the external appearance of the rock, and shewing him the effect of acid on it, he told me that, if I would come up to his place in Harrington, he would shew me miles of it; that it surrounded several lakes in his neighbourhood, and that having a small birch bark canoe, which was easily transported from one lake to another, we could visit them all. I told him I would take him at his word, and pay him for his trouble. Carrying with me a small stock of provisions, I went up a few day afterwards, to the residence of my highland friend. He is probably some distant relation of the Duke of Argyle, for his name is William Campbell. He emigrated to the country many years ago from the Isle of Skye, where he pursued the calling of a fisherman, and he has been gradually followed by a whole clan of his relations, for each of whom in succession, as for several of his sons who are all grown up to manhood, he has selected a lot of land in his own neighbourhood. Mr. Campbell first indicated to me one or two exposures of limestone on his own farm; but I soon made him understand from these and others on his neighbours lots, as well as the run of the stratification, that his farm, which is an excellent one, was underlaid by the rock from one end to the other, and it was found that on every lot he had chosen for his relations there was more or less of it, indeed on almost every cultivated lot of the settlement; and it was not difficult to convince Mr. Campbell that the soil was dependent on the limestone for its good quality. Mr. Campbell accompanied me for upwards of a week before he had exhausted all the localities, in which he had at one time or another seen the rock within a range of eight miles around his house, the greatest extent being on the lakes he had mentioned, where he had ascertained every exposure on various fishing excursions, to which at the proper season he has recourse for the purpose of supplying his family with provision for the winter. Mr. Campbell seemed so taken with our investigation, that he proposed to me to send him a compass, a hammer and a small bottle of acid, in order that he might extend his researches. These I sent him, and he subsequently brought me information to Montreal of the existence of the rock in several lots in Wentworth and elsewhere with specimens.

Several years ago I suggested to the Commissioner of Crown Lands, that the Provincial Surveyors in running lines should be requested to collect small specimens from the fixed rocks they might meet with, marking by a number on the map, the place where they occur, and attaching the same number to the specimen. If this were extensively and perseveringly carried out, a vast amount of information might be obtained, without much trouble, of the Geographical distribution of

various rocks. The package containing the specimens, should not be opened after receipt, except by some person able and prepared to enter immediately in a book, kept for the purpose, a correct description of the specimens, prefixed by the numbers attached to them ; for unless this is attended to, the labels or numbers may become detached from the specimens before a proper entry is made, and the value of the information lost. There being I believe, no mineralogist in the Crown Land Office, the packages should be sent unopened to the Geological Survey Office. If required they could be return to the Crown Land Office after entry, but it is probable they would better serve the purposes of comparison in the former. Some information has been obtained by me from Canada West by this plan, but I do not recollect of any from Canada East. I believe that specimens have been sent in to the Crown Land Office by several surveyors in Canada East, but they have never reached my hands; the intention in that branch of the department seems to be to make a considerable collection, and then send them. But as the packages have all been opened, and very probably handled by several persons, when the specimens come to me, I shall be under the apprehension that some of the labels may have been misplaced, and a doubt will attach to the whole of them and destroy their value. Without its exact geographical position a specimen is of little or no use geologically, and in regard to a collection of them I would not trust the memory of even the person who gathered them, unless he could shew marks on his map and corresponding marks on his specimens, made at the time they were broken from the parent rock.

78. Could you suggest any means of organising such voluntary assistance?—*Ans.* When the survey commenced, a set of questions was framed and widely distributed, in reply to which a considerable amount of facts was obtained, extremely useful in suggesting to me a plan of operations. These questions were of the simplest kind, and so put as to be intelligible to the commonest workman. If the information now collected on the survey were more extensively disseminated, it is probable that a greater amount of interest would be excited on the subject. Those in the country who instruct in Geology would, instead of taking their illustrations from Europe, take them from Canada. Those who learn would see at home what now reaches their minds vaguely as existing in other countries, and the number of those disposed to geological enquiry, would be increased from thus having a foundation, on which to build with the materials of observation placed within their reach. Perhaps a repetition of the questions already put forth, or a set framed to draw information on points obscure or deficient in the survey, might then be expedient, and probably a great number of additional facts might thus be ascertained from voluntary assistants. After a time, but it can scarcely be for a few years yet, a sufficient number of geological enquirers may rise up, to render it advantageous to have an annual meeting, as they have in the United States, at some convenient time and fit place, where there is a collection of materials for reference in a Museum or Mechanics' Institute, in order that they may compare their facts, discoveries and opinions. I am persuaded when we are prepared to do this effectually, the whole subject will receive a great impulse in the country, and a vast accumulation of valuable matter be the result.

79. What system would you recommend of publishing the information we have? *Ans.*—I would recommend the publication first of a map geologically colored, with symbols or lettering to indicate the localities of some of the important economic materials; accompanied by a catalogue, such as I prepared in 1850, for the purpose of promoting a collection of native specimens for the London Exhibition. The scale of the map might be from twenty to twenty-five miles to an inch.—Next a condensation of the various annual reports. This like them should consist of two parts, one devoted to a geological description of the formations, illus

trated by a few plates of their most characteristic fossils; and another to the economic materials which the formations yield. Any one, who has read the annual reports carefully, will know that the plan on which they are given comprehends, first a short description of the geographical features of the area examined; then a description of its geological formations and their geographical distribution. This part has always been so given, that any one who would take the trouble (a considerable amount of trouble I will allow) could by a proper use of colors on any good topographical map of the country, make for himself a very passable geological one, and I understand some one or two have really done it. A third part of the annual reports was devoted to the economic materials, and in this part, besides a more detailed account of their localities, there was, when occasion required, a description of their applications, and sometimes of the traffic in them. In the annual reports some of the formations have been described several times over. One general description of each will be sufficient, in the condensed report. It will be unnecessary to give much description of geographical distribution, as that will be represented on the map, but local or abnormal peculiarities, as far as they are known, should be described. This may require a general revision of the specimens boxed up in the Museum at present, not in a minutely critical manner, but so as, by a comprhensive comparison of different parts, to seize important features.

In addition to the publication of the map and condensed report, as soon as they could be prepared, there should come from the survey every now and then, plates and descriptive letter-press, say at the rate of ten plates per annum, illustrative of those new forms in natural history, which may be discovered in the prosecution of the investigation, or of such specimens of organic remains, as may give a better and more perfect idea of the aspect and structure of the animals to which they relate, than have previously appeared. Organic remains are now so indisputably considered the only true means of determining the sequence of strata, and a knowledge of this sequence is so indispensable to the success of the scientific and therefore *practical* miner, that it becomes the duty of any one entrusted with the direction of a geological survey to urge upon the Government, which countenances it, the propriety of placing before the public whatever increment he can find of such essential evidence. The interesting nature of this part of the subject attracts the attention of a great number of enlightened minds on both sides of the Atlantic, and the publication of Canadian discoveries in it would serve to keep the eyes of such men steadily fixed upon our geological results, both practical and scientific. We should also have the means of publishing maps on a larger scale than the general map, giving more detail of parts that may be considered worthy of it, from the intricacy of their structure, or the abundance of economic materials, together with illustrative vertical sections, as well as maps of rivers or lines of Country explored for the first time.

80. What number of the revised reports would you advise to be published and how would you distribute them? *Ans.* I do not think that between 10,000 and 20,000 copies would be too many, and they might be distributed among Members of the Legislature, Universities and Colleges, Mechanics' Institutes, Literary and Scientific Societies, Local Libraries, Grammar, Normal and Model Schools, Municipalities, Judges, Editors of newspapers, Scientific Societies in the United States, in Great Britain and on the continent of Europe, and the East India Company for distribution in the different Presidencies.

81. What would be the probable expense?—*Ans.* The evidence of a printer and publisher would be better than mine on this point, and the cost would much depend on the style in which the work was printed and covered; but I should suppose £2000 for the map and revised report.

82. What number of copies would you recommend of the plates and illustrations? —*Ans.* About 2000.

83. What would be the annual expense?—*Ans.* For descriptions and drawings, engraving and letter-press not less than £500; and as much for sections and maps of exploration and detail.

84. Do you think we should publish at once what we have, or would you wait till we are nearer completing the survey?—*Ans.* It would in my opinion be far preferable to publish at once. By so doing the credit belonging to the publication would be secured to Canada, whereas by delay, the credit may be lost by the same things being discovered and published by others. By early publication too we should obtain the benefit of discussion, leading perhaps to further discoveries.

85. Would there have been any practical advantage if the maps had been sooner published, and the reports and other information more extensively distributed? *Ans.* From the great demand there has always been for the annual reports, particularly by gentlemen from the United States, I am persuaded that a more extensive distribution would have led to a more early working of some of our economic materials. Within the last two years I have been repeatedly called upon by a gentleman of the name of Forsyth from Pittsburgh, who has made most minute enquiry in regard to all the beds of every discription of iron ore that are known in the Province. I supplied him with copies of all the late reports, but it is in the earlier ones, of which no copies are to be had, that the beds which appeared to interest him most, are mentioned, hence his repeated visits to get *viva voce* what he could not find in print. He informed me that his attention was first attracted to our iron ore by accidentally meeting with one of our reports on board of a steamboat in the course of his travels, and I find that he and several partners have lately established themselves at Bytown, and made arrangements to work the great bed of magnetic iron ore in Hull. A few months ago I received a letter from the firm (Forsyth & Co.), strangers to me except in so far as their enquiries have made them known, and after several additional enquiries they say. "We cannot close "our letter without expressing our warmest thanks for the kind manner in which "you have afforded us information, relative to the mineral wealth of Canada; and "hope that our present enterprise is but the pioneer to others. Ours, we must "say, has been entirely brought about by yourself." A greater distribution of the reports might have carried copies to the hands of persons similarly disposed in respect to other materials in other parts of the Province. Some time since, Mr. Samuel Keefer, C. E., called at the office of the survey, and requested permission to examine the map, on which we had represented the various formations of the Province; after poring over it some time he exclaimed, "Now I see where I am to get my materials;" on asking an explanation he informed me he meant the building materials required for the purposes of the railroad from Kingston to Toronto. By this I judge that if the map had been published sooner, it might have been of service to railroad engineers. Mr. Gzowski, in one of the reports of the St. Lawrence and Atlantic railroad company, gave public thanks to the survey for the information afforded him in respect to building materials.

86. Can you mention any instances, which have come to your knowledge, of mistakes made in consequence of ignorance of the results you have already obtained, in consequence of their not being published at all, or insufficiently distributed? —*Ans.* On arriving at the seat of Government, then at Kingston, after my first examination of the Gaspé coast, and before any report could possibly have been

published, I found that an Act had just been passed establishing the Gaspé *Coal* and Fishing Company. In conversation I expressed the opinion, that there was no coal where the company intended to sink for it. This reaching the ears of a gentleman interested in the adventure, he requested me to give him in writing, for the benefit of the company, the reasons for my opinion. The reasons resolved themselves into this, that the bituminous shales, in which the coal was expected, came almost visibly from beneath certain rocks, which had been ascertained by their fossils to be of more ancient date than the Carboniferous, and that the shales themselves holding *graptolites*, fossils never found so high in the series as the coal, it would be contrary to experience to find coal in them. The company which was an English one, having very probably submitted my letter to competent judges of the evidence, instead of paying a large sum of money down, (several thousands of pounds) for a property supposed to contain coal, which was the arrangement contemplated, got the conditions altered to the effect that they should pay down the money when the coal was found. Miners were subsequently sent out, but I have not heard of the discovery of the coal. The Act making this association a *Coal* Company was a mistake arising from our results at the time not having been published at all.

In the spring of this year a communication, with somewhat of a learned air, was made to the Owen Sound *Lever* by a Collier, perhaps a practical one, to the effect that he had been informed by different persons, that a geologist had reported to the Government that there was no coal in Upper Canada; but that he had a fragment of bituminous shale from Collingwood, and if the geologist was acquainted with the vegetable origin of coal, and if he knew that naptha was proved to be a part of it, he would ask him, if the bitumen in the shale did not come from coal, where did it come from? Knowing that the present theory of the origin of coal—growth in situ and submergence—is founded on my own discoveries, I felt that my light, some how or other, had got hid under a bushel. Mortified at this, I might have come down on the practical Collier with a graptolite, a fossil which abounds in the Collingwood shale, and as stated before is never found associated with coal, being of much more ancient date. But I observed that in one part of his communication he said, that if the geologist, who is said to have made such a report to the Government, has grounded his opinion upon the out-cropping and order of certain strata, together with their direction, dip and other indications, and provided he did not overlook the bituminous shale, then he would have been probably following the right track to arrive at a just conclusion. The first *ifs* looked rather bellicose, but the last were peace makers; there was some appearance of good common sense in them; I therefore merely asked myself how it came about, that the practical Collier, before running the risk of mistaking the whole case, did not really ascertain what the geologist had said in regard to this bituminous shale. By consulting our reports he would have found that we had given these particulars and others in regard to it, for a range of 1000 miles through the country. On reflection, however, it occurred to me that the practical collier was not so much to blame after all. Where could he or any of the inhabitants of Owens Sound ferret out a copy of these reports? His is a case shewing insufficient distribution of them. I am persuaded from what he has written, that if he met with the reports, he would read them and understand them. If he should come to Montreal, I hope he will pay a visit to our museum; by shewing him the geological model, which now stands on the table of the Committee, he would without one word of explanation thoroughly understand, that the bituminous shales in Collingwood are a great depth beneath the coal of Michigan, and I would have an opportunity of telling him that if he took a fragment of the shale, with a graptolite upon it, to the other side of the Atlantic, and shewed it to my friend Sir Roderick I. Murchison, whom I think he cites, Sir Roderick would at

once tell him, without knowing anything about Collingwood or the dip and strike of the shales, "There is no coal under this." If the case were such, that the collier could truly say the dip of the nearest coal and that of the shale were in such relation, that the coal appeared to run under the shale, he would be told, "Then there must be some dislocation or some undulation between them, or they must both be turned upside down by a plait or fold in the stratification." If however he could prove to the satisfaction of a jury of the first geologists of Europe, that the graptolite shale was visibly above the coal, and that they were *not* turned upside down, to do which he would have to submit to the ordeal of a cross examination, and experience a difficulty that would probably surprise him, then it would be a new fact in Natural History, and he would be immortalized as its discoverer. By means of the Provincial and American press the Collier's letter obtained a wide circulation, and the question of coal in CanadaWest was beginning to be agitated in so serious a manner, as might have led to futile but expensive borings in the bituminous shale, and affected the value of property in its vicinity, had I not fortunately, in the beginning of the year, communicated to the Toronto Institute a paper on the Physical Structure of the Western District of Upper Canada, with a geological map of nearly two thirds of the Upper Province. These comprehended the whole subject, and the publication of them in August last in the Journal of the Institute has, I should think, settled the question in the minds of all sensible men, even in that of a correspondent of the Agriculturist, who would appear, by some theory of a universal north-east strike and south-east slope, to suppose it probable the coal of Illinois might run through Canada West. I beg to submit a copy of the map to the Committee, who will see from the distribution of the formations, that looking only to the upper end of Lake Erie, such a theory would carry the Carboniferous rocks of Michigan with the upper part of the Devonian on their back, some 6000 feet beneath the Carboniferous of Appalachia, with the upper part of the Devonian lying under them, where it ought to be, while the lower part of the Devonian would run between. If it were only to save the community from the influence of such—shall I say *half* learned writers, whose assertions uttered in an authoritative tone might produce mischief, it would be proper that a map should be published. What people wish they readily believe, and are thus easily deluded into costly experiments. They are sometimes, not very well pleased when you undeceive them. I was rather gruffly informed by a magistrate at Isle Percé, to whom I was explaining the reason why he was unlikely to have coal on his property, that if I had come there to prove he had no coal, he would rather I had kept away; he would rather think himself rich than know himself poor. Without the the evidences of a careful investigation before their eyes, what is to prevent any designing person, who may have just such a mixture of modesty and morality in his composition, as would induce him to act on this weakness of humanity, from deluding the inhabitants of Quebec as to the probability of coal in this neighbourhood. You have the same graptolitic shales close at hand, and even small lumps of indurated bitumen, and yet the true Carboniferous area, beneath which they descend, is spread out in New Brunswick.

87. Do parties frequently apply to you for information?—*Ans.* Nearly one half my time during the day is employed in giving information to applicants. I have therefore to do most of my work at night, and seldom get away from the office until midnight and sometimes one and two o'clock in the morning.

88. Can you mention any instances of new facts established by your survey of a scientific character?—*Ans.* The Laurentian series of rocks constitutes a mountainous region from Labrador to the Arctic Ocean. The first fossiliferous rocks on the south side of it belong to the Lower Silurian series. This series, we have shewn, is wanting on the north, the first fossiliferous rocks there met with being of the Up-

per Silurian age. The inference is that the north side was above water during the Lower Silurian period, while the south was beneath it, and the Laurentian series, for many thousands of miles, would thus appear to have been the limit of a Lower Silurian Sea—a great fact in palæozoic geography.

The want of conformity in what I have called the eastern area of Canada, between the Lower and Upper Silurian rocks, and between the Devonian and the Carboniferous, with the fact that the successive disturbances in them all run in lines having parallel directions, has enabled us to shew, that a uniform set of forces producing the undulations have been in operation, from the time of the first traces of organic existence on the face of the globe, until the termination of the Carboniferous era,—a great fact in geological dynamics. A paper on these subjects was read by me before the British Association at Ipswich in 1851, and it was considered of sufficient importance to obtain the recommendation of the geological committee, that it should be printed in full in the reports of the Association, the papers in general being printed in abstract only.

We have ascertained that certain fossil and recent shells, instead of carbonate, are composed of phosphate of lime, by which has been broken down a heretofore supposed distinction between the skeletons of vertebrate and invertebrate animals. Professor Agassiz and other naturalists appear to think that very important results will flow from the discovery.

The age of the gold-bearing rocks in North America has heretofore been considered anterior to the fossiliferous, but our investigations from Gaspé to Vermont shew them to belong to the Silurian epoch.

Many mineral species have been analysed and several new ones discovered by Mr. Hunt, and his results have all been adopted by Dana, acknowledged in Europe and America to be one of the first authorities, and by all the various European mineralogists.

89. Can you mention some cases of practical advantages resulting from the survey? —*Ans.* Limestone is almost an indispensable necessary of life. Those whose houses stand on the rock and who know it, never having experienced the want of it, can scarcely appreciate the inconvenience of those far removed from it. It has often given me great satisfaction to surprise a settler by shewing him, that he might have as much of it at his own door for six pence, as has for years in succession cost him, all circumstances taken into consideration, ten times the money, getting it from a distance. Almost every settler seems to know the calcareous character of the blue fossiliferous limestone, but very few that of the white crystalline rock of the Laurentian series. A respectable farmer in one of the townships on the north side of the Ottawa above Bytown with whom I met, seemed to have made the blue limestone his peculiar study. He was able to tell me of every visible patch of it within miles of his dwelling, and he gave me a great amount of valuable information in regard to its distribution. He had been able to find no patch of it, however, sufficiently near his residence to satisfy him. A limestone quarry on his own land appeared to be the height of his ambition; and after expatiating on his regrets, he finished by saying:—"Now, if you will find limestone near this, I'll give you five dollars," "Why, my good friend," I replied, "you are standing on limestone." He would scarcely believe me until I told him what effect acid would have on the stone, and then put it to the test. He expressed the greatest wonder that he should have been many years almost daily walking over what he was in search of without knowing it, and much resembled a man who has been for some time looking for his spectacles, when a friend informs him they are on his face.

The Honorable Mr. Morin has property in the rear of Abercrombie. He often asked me when we were likely to go out into that neighborhood, as the whole settlement in Morin and the rear of Abercrombie and Mille Isles were in the habit of making a good deal of potash, and much felt the want of limestone. In his visits to the locality, he had often, he said, searched the country round trying every rock

with acid, but without success. Mr. Hunt and myself went to the place last year, and on the second day of our exploration we discovered a wide band of the crystalline limestone and traced it for four or five miles in Mille Isles and Morin. We found that one of the settlers in Morin had accidentally discovered, by burning in a log heap, that it made excellent lime, and he was encouraged to build a very good limekiln on it. Confident of success he quarried into what appeared to him the same description of rock close behind his kiln, which he loaded with the fragments. After permitting it to burn for the usual time, he was much surprised to find in his kiln, instead of lime a half-melted slag-like mass all adhering together. He asked me for an explanation. I shewed him that behind his kiln the limestone came up to a certain line, and that it was succeeded by feldspar. He had passed over the limestone and chosen the feldspar for his lime burning experiment. He could not see the difference; both were white, and both were crystalline; but I exhibited to him by the use of a knife, that one was much harder than the other, and by the application of an acid that their properties were very different. The inhabitants of this settlement have been in the habit of sending to the front of Abercrombie for a very inferior lime, and in preference to St. Anne-des-Plaines and St. Lin for a better quality. These places are from twenty-five to thirty miles from the settlement, and I was informed by one of the inhabitants, that the burning of lime in the settlement would occasion a saving of four or five dollars yearly to every man in the place. There is much good soil on the top of the hills and much hard wood, and hence the potash.

In searching for the limestone we found that a large part of the mountains, whose slopes hold the good soil, is composed of what has been called *hypersthene* rock, from the occurrence in it of a mineral of that name. The rock, however, as ascertained by the analyses of Mr. Hunt, consists largely of lime feldspar, and hence the good quality of the soil. The beautiful mineral *labradorite* is one of these lime feldspars, and *andesine* is another. The former, when first discovered, used to be sold on account of its beauty, for its weight in gold, and applied to the purposes of jewellery. Now, ornaments cut in it are worth no more than the value of the labor expended on them. We have found it in abundance in the rock. The granular soils, from the crystalline limestones, are well known to be fruitful. On such a soil I have seen a field of oats every stalk of which was upwards of five, and a large number six feet high, with good grain at the head. The valleys underlaid by the rock have always constituted, in my mind, the main hope for the Laurentian country in an agricultural point of view; but the discovery of important ranges, largely composed of lime feldspars, greatly extends the prospect of advantage. These rocks have been met with in several localities, from Abercrombie to the Sault-à-la-Puce in Chateau Richer; and as the Laurentian series in which they occur reaches from Labrador to Lake Huron, they are a subject of real importance to both sections of the Province.

From Harrington to the front of Grenville the inhabitants have for years been accustomed to ride over the crystalline limestones, which we have pointed out to them, to get lime from the fossiliferous beds on the bank of the Ottawa, the roads running on the other kind the whole way, a distance of some twelve to fifteen miles. The same thing occurs in the western part of Chatham and Wentworth. In the east of Chatham and about Lachute, they have by some accident found out the character of the rock. Mr. Lane of Lachute, however, informed me that it is not a very great many years since the discovery was made—some twenty or thirty. Before it, the inhabitants sent to the bank of the Ottawa to the fossiliferous rock.

The practical advantages arising from the survey are only beginning to be felt. A great many substances have been pointed out that can be made available for domestic use, as the catalogue of them that has been published, and the specimens sent to the London Industrial Exhibition, very well shew. Discoveries usually lie dormant for some time after they are made. You may write about them, but can-

not always get people to read, particularly if you circumscribe the distribution of what is written; and it often requires some accidental circumstance to bring them into operation. It is several years since we indicated that roofing slates existed in the Eastern Townships, and specimens of them were sent to the London Exhibition from several parts; but it was only after the conflagration which destroyed so large a part of Montreal, that the Corporation interdicting shingle-covered roofs, the slates mentioned by the survey occurred to the recollection of Major Lachlan. He addressed a communication to the Montreal Gazette on the subject. This attracted the attention of Mr. Scobell and induced him to make arrangements for opening a quarry on one of the lots pointed out. He subsequently tempted Mr. Hubert, an advocate in Montreal, to join him, and a number of houses were covered with the slate. The advocate prudently considering that he understood law better than stone, thought it advisable to sell the quarry at a large profit; and those who purchased it had at one time during the summer sixty men at work in it, who were wholly unable to supply the demand. The proprietors I am informed could easily have sold £20,000 worth of slates if they had been ready. I understand a branch railroad is nearly completed from the quarry to join the St. Lawrence and Atlantic at Richmond, only a few miles distant. The moment it was observed by the farmers in the neighbourhood that here was a stone that might be turned into bread, every one began to search his own lot and try the schists that presented themselves. The result is that many find they have the same material, and many more will continue to find it. An example is worth twenty reports. Few read but every one can see, and this example became for the vicinity, and in regard to this one material, what I wish to make the economic department of the museum for the whole public and all our materials. If a railroad should be carried up the Chaudière Valley the example will spread its effects there, as the slate will there be obtained in equal abundance. Several of the specimens of slate sent to the London Exhibition were from that valley. Soapstone is a material pointed out as existing in abundance. There are many establishments in the States whose business is devoted to the manufacture of it alone, and the Canadian localities are coming into operation. From what we have reported of peat and from the dearness of domestic fuel, a person in Montreal has commenced preparing and selling it for house use, at $5 per cord of 128 cubic feet unpressed, and $12½ for the same bulk pressed. He tells me that braziers and blacksmiths have been using some of it to their satisfaction, and I am aware that some enquiry has been making about it for the smelting of iron. It is used for such a purpose in France and other countries. It is known that 40,000 people are employed in France in the preparation of peat in various ways.

90. Do you think a fuller and more complete survey would produce similar results for the future?—*Ans.* There can be no doubt of it. In a geological survey of a new country, at first you obtain only a general sketch, as it were, of the subject, which you must fill up afterwards by degrees, and the more you enter into detail the greater will be your results. What you first point out will furnish the means of farther discoveries. The working of the first useful materials ascertained is almost certain to disclose facts that will point to the existence of others, and as you find different parts of the country fruitful in results, it may become advisable to extend researches in them. The very clearing of extensive tracts of forest, by producing a greater number of rock exposures, will occasionally render it expedient to go over them in greater detail than at first.

91. Can you give any instances of wasted capital for want of full geological knowledge?—*Ans.* The waste of capital in useless researches for coal in various countries is notorious. Sir Roderick I. Murchison has said that it would be sufficient to effect a geological examination of the whole surface of the globe. Professor Hall has men-

tioned American instances, and Professors Forbes and Ramsay, of the Government Geological Survey of Great Britain, give numerous ones in the British Isles. Professor Forbes states that considerable funds were expended uselessly in a western district of England. The adventurers, ignorant of geology, had set to work in dark Silurian shales. Their mineral aspect resembled that of certain coal shales with which they were familiar. Had they possessed even a moderate knowledge of fossils, they would have abandoned their costly and profitless experiment at the beginning; for the strata were marked by graptolites, extinct zoophytes, (*the Collingwood case*), which range no higher than the lowest fossiliferous group of rocks, and the presence of which indicated the character of the strata beyond question. The fossils did not escape the attention of the miners, but, unable to distinguish differences, they mistook them for coal plants, and were confirmed by them in their error. As the Professor states, they might have bored through the centre of the earth without attaining the treasure they were in search of; their only chance of reaching it was by penetrating to the antipodes. Mr. Murray, in our first report, mentions a Canadian case,—"Many of the settlers," he says, "in the country underlaid by this formation," (the bituminous shales of the Hudson River group,) "seem to be strongly impressed with the opinion that it contains coal. In some instances I found them unwilling to listen to any reasons, which might interfere with their prepossession; and while a few, possessed of indications satisfactory to themselves, carefully conceal from general knowledge all information of the localities of their supposed buried treasure, through the apprehension, I was informed, that the Government would claim a right to all minerals discovered, others have proceeded more boldly to work, and have bored a considerable depth in search of the material. At Weston, on the Humber, I found that a company of adventurers had been partially formed, boring rods provided, an old miner employed, who, I believe, was a speculator in the concern, and the rock penetrated to a depth of 150 feet. Having, when two-thirds of the distance down, passed through a band of shale of darker color than usual, it was pronounced to be coal, and the work was continued in confident expectation of a large seam, until a deficiency of funds more than a want of hope caused the suspension of the operations." A bore hole was sunk at the upper end of St. Helen's Island in similar shales, with the same object. Another, I understand, was tried near St. Andrew's, in still lower rocks. It appears to me not improbable, that if the value of all the labor wasted in the Province in the mere transport of lime from great distances to spots, where it might have been procured with facility in the vicinity, could be computed with accuracy, it would amount to a much greater sum than has been devoted to the geological survey

92. Can you give any illustration of the manner, in which a sound scientific basis leads to practical economical results?—*Ans.* A considerable portion of the science of geology is devoted to tracing out the distribution of the various formations, that come from beneath one another and spread over the surface of a country, the mode of representing these being by colors on a map. What is this, in an economic point of view, but a classification of its surface into parts, each of which will give useful materials peculiar to itself? So much is this the case that Dr. Buckland, in his Bridgewater Treatise has shewn that a geological map of England is a map also of the distribution of its manufactures. Such a map will point out the limits to be observed in searching in new localities for materials that are known, and make every man's discovery of any useful material, not previously known, available to his neighbours in a hundred new places. For example, I was informed not an hour ago by Dr. Taché, that Mr. Gauvreau, of Quebec, has made from some of the strata on which the city stands a very good cement. It will immediately be seen by those acquainted with the geology of the country, that this is a discovery not for Quebec alone, but for hundreds of places between this and Missisquoi Bay, and for hundreds of places along the south side of the St. Lawrence below this. Accidently meeting Mr. Lloyd of

Quebec, yesterday, who has property in the Township of Inverness, I believe, he said that he was very desirous of finding limestone in the neighbourhood of his mills, but that he believed I was of opinion it was not likely to be met with there, at any rate he knew I had made a rather careful search, and found none that satisfied me. I informed him that the reason of my careful search was that it ought to be there, and very probably was there, though covered up by drift or forest, as the rocks of the vicinity were equivalent to those associated with limestones at Point Levy, which, as I showed him on the map, would be carried by undulations through that part of the country. He told me that he had recently heard that it existed on the lot of one of the settlers in the neighborhood, and after my explanation he was disposed to credit it.

Copper ore has been pointed out and traced some distance in Inverness. The lode occupies a position in the Lower Silurian series of rocks (the top of the Hudson River group). In the report of progress for 1847-8, I stated that it was worthy of trial. Let us suppose that a successful mine were established on it. The result would give importance not merely to the ground in which the lode is immediately visible, but to all that belt of the Lower Silurian series in which the ore occurs, wherever the belt might run, provided the rock were in all cases in the same condition in respect to metamorphism; and the many cupriferous traces it contains in various parts, which otherwise would scarcely justify more than a passing notice, would become worthy of more serious attention. The general distribution of the rock could be made out from the map, and researches for the ore would thus be greatly facilitated.

93. Have you in your survey had as your principal object the establishment of new scientific facts, or has your attention been more directed to discovering and pointing out economic advantages?—*Ans.* The object of the survey is to ascertain the mineral resources of the Country, and this is kept steadily in view. Whatever new scientific facts have resulted from it, have come out in the course of what I conceive to be economic researches carried on in a scientific way. Take the scientific facts given in reply to Question 88. The fact in Geological dynamics is a result of the examination that was necessary to ascertain the Northern limit of the coal field of New Brunswick, a most important economic investigation in so far as Canada is concerned. The double discordance discovered in the investigation rendered it possible, that outlying patches of the coal formation might lie unconformably on the Devonian, the Upper Silurian or the Lower Silurian of the Gaspé Peninsula; hence the propriety of the transverse explorations between the St. Lawrence and Bay Chaleur, of which two were completely across and several partially so. These have much narrowed the chance of coal there, but they have not quite exhausted it. They have, however, so much narrowed it, that it was considered proper to postpone further examination there, until other parts of the Country had received their share. The area of Canada is so large and the explorers so few, that we could not satisfy public expectation if we dwelt a very long time on one district.

The fact in Palæozoic Geography is a result of our economic researches up the Ottawa, combined with previous observations on the northern country by various persons. Our main object was to ascertain where the fossiliferous rocks began to dip northward, in order to determine what chance of coal there was in that direction. The Lower Silurian series was found wanting, hence the scientific inference. The probability of coal, however, if any exists in that direction, was out of the limits of the province. But though the coal was a negative quantity, other materials of an economic character were ascertained to exist.

The obliteration of the mineral distinction between vertebrate and invertebrate skeletons, results from economic researches for phosphate of lime, and the

discovery may become of economic importance, not only to Canada but to other countries. In communicating it to the Director of the Geological Survey of Great Britain, I drew his attention to the fact that, if these phosphatic shells were found in any part of what are called the *Lingula beds* of his lowest series of fossiliferous rocks, in the same abundance that calcareous shells are in the calcareous rocks, the farmers of England would have to thank Canada for pointing out another source of this mineral manure.

Mr. Hunt's valuable contributions to the London Philosophical Magazine and other scientific journals of repute on the Metamorphism of rocks, which I should have mentioned in connexion with Question 88, are the result of chemical analyses made to compare the constituents of European roofing slates with those of Canada in reference to probable durability, and of other analyses with a more scientific end, that of determining whether shale, caught as it were in the act of Metamorphosis through contact with trap, and becoming what he has called *parophite*, from its resemblance to serpentine, really contained the same chemical constituents in both cases. He found that it did so. But while the economic analyses became related to a scientific result, the scientific analyses pointed to one that might become of economic value. The shale was found to contain so much potash, that it would not be surprising if in some cases such schists might turn out profitably available for this substance.

The analyses of new mineral species, while they directly regard a scientific results, must always have also an economic bearing. You cannot tell whether a new substance is to be profitably available or not, until you have ascertained its properties? The analyses of mineral species led to our knowledge of the lime feldspars of so much agricultural importance to the Laurentian Country.

Thus economics lead to science and science to economics. The physical structure of the area examined is of course especially attended to, as it is by means of it that the range or distribution of useful materials, both discovered and to be discovered, can be made intelligible. A strict attention to fossils is essential in ascertaining the physical structure. I have been told that some persons, observing how carefully attentive I endeavour to be to this evidence of sequence, have ignorantly supposed the means to be the end, and while erroneously giving me credit as an authority upon fossils, have fancied economics to be sacrificed to them. In their fossil darkness they have mistaken my rush-light for a sun. I am not a naturalist. I do not describe fossils, but use them. They are geological friends who direct me in the way to what is valuable. If you wish information from a friend, it is not necessary that you go to him, impressed with the idea that he is a collection of bones peculiarly arranged, of muscles, arteries, nerves and skin, but you merely recognise his face, remember his name, and interrogate him to the necessary end. So it is with fossils. To get the necessary information from them you must be able to recognise their aspect, and in order to state your authority you must give their names. Some tell of Coal; they are cosmopolites; while some give local intelligence of Gypsum, or Salt or Building Stone, and so on. One of them whose family name is *Cythere*, but who is not yet specifically baptized, helped us last year to trace out upwards of fifty miles of hydraulic limestone.

My whole connexion with Geology is of a practical character. I am by profession a Miner and a Metallurgist and for many years, was one of the active managing partners in an establishment in Wales, where we annually melted 60,000 tons of copper ore, and excavated 60,000 tons of coal. It was my constant occupation to superintend and direct the minutest details of every branch of the business. A due regard to my own interests forced me into the practice of Geology, and it was more particularly to the economic bearings of the Science that my attention was devoted.

94. What do you think should be the object of a Provincial Survey in an economic point of view? And what kind of information should be expected from it?

—*Ans.* The economic object of a Provincial Geological Survey in my opinion should be to indicate in a comprehensive way, and in as short a time as possible, the mineral resources of the Country, and the character and composition of its rocks, as leading to a knowledge of the origin and constitution of its soils. But the true mineral riches of a Country do not consist of its gold and its silver, but of those more common materials, which possessing little or no value as they lie in the earth, are yet capable of supporting a large amount of labor in receiving the forms, in which they become applicable to the wants of man. Where these are in fortunate combinations they may sometimes originate exports, but they can scarcely fail in any Country to be largely required for domestic use and afford employment to a great number of its inhabitants. Coal and iron are two of the materials, the presence or absence of which should be immediately ascertained. Limestone should be brought as near as possible to every man's door, and among the various substances capable of employing native industry, to which researches should be directed are common and refractory clays, building stones, slates, mineral manures, combustible materials, grinding materials, mineral paints, and a multitude of other things too numerous to be mentioned. Wherever these materials are found they are usually in quantities that are large and certain, and all that relates to them is easily calculated; and they would therefore constitute a safe foundation for Manufactures. Metalliferons veins are of course to be carefully attended to in a Geological Survey, but from their very nature, without considerable preliminary expense no approximation to true results can be formed. I have given a description of the nature of a mineral vein in the report of 1849, on the North shore of Lake Huron, page 29, and if the Committee will do me the favor to refer to it, they will see with what caution mineral veins should be approached in a new country. In old mining countries analogies guide the miner to an opinion in new lodes in a known mineral district; but it would be dangerous to place too much confidence on these analogies, a thousand miles distant, in regard to results that in the nature of things are unavoidably attended with great uncertainty. All that can therefore safely be done in regard to mineral veins is to state their existence and describe their character where they are visible, leaving it to private enterprise to ascertain the expensive facts necessary to lead the way to a sound opinion in respect to quantitative returns. Even a moderately effective examination with this regard in any one locality would sweep away more than the whole funds at the disposal of the Survey for a season's exploration. It is not to be expected that the Geological survey of a country is to discover every economic mineral that exists in it. For centuries after the very best that could be made is finished, new materials will be brought to light; but one great duty of those who conduct such a survey, and perhaps it is the most essential, is to ascertain physical structure to the fullest extent the means placed at their disposal will allow, and to represent it. This is a work, the benefit of which will be be felt for all future time, for as stated already, by this you arrive at a classification of the surface into parts, which, each in respect to a certain set of materials, limit the distribution both of what is known and what is to be known, facilitate discoveries, and make available to a multitude of his co-inhabitants, whatever mineral product the intelligence or good fortune of any and every individual may enable him to bring before the world. Even in an old country like the United Kingdom, where so great a number of her mineral products has been so long known, that we might despair of additions, it has but recently, it may be said, been thought wise by the people, that this classification should be accurately and minutely carried out, and new discoveries have been the consequence; its expediency therefore cannot be doubted in a new country at the beginning of its career, when there is so much to learn and so much to be made known respecting its mineral resources.

95. Do you think it would be advisable to send a Geological Collection to the Paris Exhibition?—*Ans.* I certainly think it would be a very beneficial thing to send a Collection of Canadian Economic Minerals to Paris.

96. Do you think any great benefit resulted from our contributions to the London Exhibition?—*Ans.* In my opinion the London Exhibition was one of the most splendid and successful advertisements for Canada in regard to Minerals and every thing else that could have been contrived. She then became known to thousands upon thousands of just such people as she in various ways wants, who might otherwise never have dreamt of her resources.

97. Could you collect materials in the interval, which would do credit to the Province?—*Ans.* I could, with great exertion, make a Collection that would very much resemble that sent to London, the masses, perhaps, not quite so large, and not so many pieces or specimens from each place.

98. Would you expect to get much aid, in collecting specimens, from others?—*Ans.* I should be very happy to receive aid from others, but I must not calculate too much upon it.

99. Would not some pecuniary aid be required for the purpose?—*Ans.* The London Collection cost about £150 in travelling expenses, assistance from labourers and freight to Montreal. Wages are now double, labourers do scarcely more than half-work, and the rivers will soon be frozen up.

100 Do you think it would also be advisable to send a Collection to the Sydenham Crystal Palace?—*Ans.* As the Exhibition at the Sydenham Palace is a permanent one, it could be made the means of a constant reference to the productions of Canada, and a Collection of them there could not fail to be of advantage.

101. Have you had any proofs hitherto of the estimation in which your labors in this country are held by foreigners?—*Ans.* Mr. DeVerneuil, in a paper communicated some years ago to the Geological Society of France, of which he was then President, *Sur le parallélism, des dépôts paléozoïque de l'Amérique Septentrionale avec ceux de l'Europe*, in remarking on the extraordinary thickness of the Carboniferous rocks of Nova Scotia (14000 feet) given in our First Report of Progress, observes: *C'est à M. Logan, directeur des travaux Géologiques, qui s'exécutent dans le Canada par ordre du Gouvernment, et l'un des observateurs les plus exacts et les plus consciencieux, que l'on doit la connaissance de ce fait si intéressant. Ses mesures ont été prises sur des couches légérement relevées, et qui affleurent sur les côtes de la mer, en sorte qu'elles offrent un grand degré de certitude.* In the same paper, in his remarks on the palœzoic fossils, he says on the *Orthis Verneuili: C'est avec un sentiment de plaisir que nous avons reconnu cette belle espèce des couches siluriennes inferieueres de la Russie dans les magnifiques collections de M. Logan a Montreal. Ce savant distingué l'avait trouvé a Jessop's Rapids, sur la Rivière Ottawa, dans des couches du même âge que celles de Trenton.* What he calls a magnificent collection was a very small part of that belonging to the Province, the result of two seasons work.

Mr. Taylor in his Statistics of Coal (to be found in the library of the House of Assembly,) a work which has been most favorably criticised by the Edinburgh Review, and of which I understand a second edition is in preparation, quotes freely from the Reports of the Canada Survey in several places. In speaking of my Joggins section he says: "This section is one of the most remarkable ever accomplished, and may be quoted as a model of close investigation, and extraordinary accuracy, in developing an enormous series of beds. It comprises the vast group of coal measures which are displayed along the cliffs locally named the Joggins, of the sea shore at Chignecto Bay. The locality so singularly favorable for taking the strict admeasurement, and constructing an exact section of the vertical thickness of the coal formation, has been frequently alluded to by geologists

and travellers ; it remained for Mr. Logan to demonstrate by a laborious survey, the true thickness of the whole group in northern Nova Scotia. His section is subdivided," &c., &c., &c. Mr. Murray is also quoted by Mr. Taylor.

Mr. Horner, when President of the Geological Society of London, some years ago in his anniversary address, occupied several pages with a minute analysis of my Joggins section.

Sir Charles Lyell, and Mr. J. Dawson of Pictou, in a joint paper to the Geological Society of London last year, touching some of the phenomena of part of the same ground, requested me to allow certain results deducible from my section to be incorporated with their remarks.

Mr. Dawson, who is an excellent Geologist, and has contributed many valuable papers on Nova Scotia to the London Geological Society, on the receipt of the Canada Report for 1851-2, writes to me, "You are certainly making an admirable Survey, better I think than any in the United States."

In an article in the Quarterly Review for October 1851, on Lyell, the Beauharnois footprints are alluded to, with a passing compliment on the caution and experience of the chief of the Geological Survey of Canada.

In an article on The Future of Geology in the Westminster Review for July 1852 it is said, "The Colonies and dependencies of Great Britain are not without their explorers. In Canada there is a state Survey far advanced under the direction of Mr. Logan, the scientific results of which already rank with any produced from European Institutions of the same kind."

Mr. Hunt's communications to Silliman's Journal on points connected with the Survey of Canada, have been twice copied, (a rare occurrence) without solicitation into the London Philosophical Magazine, conducted by Sir D. Brewster and others. Mr Hunt has sent other articles at different times to this Magazine. His analyses of mineral species and his various results with regard to them have been adopted, as already said, by Dana, one of the first if not the first Mineralogist of the day, and he is quoted in the works of French and German authors, among the former of whom MM. Gerhardt and Laurent in their *comptes-rendus*, I believe, compliment him very highly.

The Reports of the Survey generally, and Mr. Hunt's communications to Silliman's Journal and the American Association on Canadian Geology are largely quoted by Sir J. Richardson, in his Arctic Expedition, lately published.

102. What annual grant do you think would be sufficient to carry out all the objects, which you have recommended to the Committee, in an efficient manner?—*Ans.* Not less than £500.

[*Witness withdrew.*]

The Reverend *Andrew Bell*, of L'Orignal, examined :—

103. Are you familar with the science of Geology ?—*Ans.* I have paid considerable attention to it, for a number of years, and am tolerably acquainted with it ; and in the course of my visits to different parts of the Province, in the way of professional duty, during the last 25 years and upwards, I have improved these opportunities so as to make myself intimately acquainted with the Geology of Western Canada especially.

104. Are you well acquainted with Mr. Logan's Reports, and with the progress of his Survey ?—*Ans.* I am well acquainted with these reports, having, from time to time as they were published, obtained a complete set of them, and having given them a carefull and thorough perusal at the time of their publication, as well as subsequently, when I had occasion to refer to them. And I am also well acquainted with the progress of the Survey, not merely from the reports, but from having frequently in different parts of the Province, particularly in Canada

West, met with, and heard of, the different parties employed, and thus knowing the progress which had been made, which my own acquaintance with the Geology of Canada, enabled me both to understand and appreciate.

105. What is your opinion of the accuracy and extent of the information hitherto obtained ?—*Ans.* Comparing these reports with the Geology of the country so far as I am acquainted with it, I have always found the information contained in them to be exceedingly accurate ; and considering the vast extent of territory to be gone over, as contrasted with the means at Mr. Logan's disposal, the amount of information obtained in regard to the whole, has been very great.

106. What is your opinion of the importance of the results in a scientific point of view?—*Ans.* Besides bringing out to view the relative age of the rocks of Canada, and their place in the Geologic scale, as well as their Geographical distribution, and thus filling up what had previously been almost a blank in the Geological Map of the world, the Survey has shed a great deal of light on the whole structure of this country, and the various movements and changes which have from time to time taken place ; and amongst the many fossils brought to light, affording the means of a deeply interesting comparison with those of other countries in which the same formations occur, a number of new ones have been found of much scientific interest, all going to shed light on the former condition of things in this part of the Globe. Further, the scientific acquaintance, which has been obtained with the structure of the country, can be made available in more easily tracing out materials of economic value. And, moreover, when some of the formations occurring in this Province, have been traced through to the neighbouring Provinces and States, and connected there with some, concerning which doubts may have been entertained, the whole are thus more clearly and satisfactorily understood. And the Provincial collection of fossils and minerals made during the Geological Survey, when once properly arranged, will form a noble contribution towards the advancement of science.

107. What is your opinion of the practical advantages which have as yet been derived from the Survey ?—*Ans.* The Survey has shown very fully in what ranges of country various minerals of economic value are to be found, as well as where they are not to be found,—and, to a very great extent already, where they *actually are found*,—In the case not only of the more common materials employed in building, such as limestone of the best descriptions, brick clay, roofing slate, hydraulic cement &c., (and this is often a matter of no little importance to architects and engineers,) but of the metallic ores, marbles, gypsum, &c., &c, the Survey has already brought to light facts sufficient to show that the mineral wealth of Canada is enormous, affording materials for the useful and profitable application of labour, skill and capital, to an almost unbounded extent, and of course all tending towards the future and progressive prosperity of the Province. The *discoveries* of the Geological Survey have already ministered largely to the wealth and prosperity of the Province ; as for instance in the case of the roofing slates in the township of Kingsey, C. E., as well as in other instances. But as I believe Mr. Logan is prepared to bring forward a number of instances of this kind, I need not trespass on his peculiar domain. I may however be indulged in a few remarks in regard to two matters of great importance—iron and coal. In regard to iron, although less sought after than the more precious metals, it is nevertheless known that we have in various parts of the Province immense masses of iron of first rate excellence, the same in fact, as that which is imported from Russia and Sweden, for the manufacture of all the finest cutlery and all the steel used in Britain, and as this is a matter of national importance, it is well worth the consideration of the Legislature whether such encouragement could not be given to

the manufacture of native iron, as not only to furnish a home supply for the prodigious demand for railway purposes, but also to create even a foreign trade in the best sorts, furnishing to Britain at all events that supply, which has been heretofore furnished by Russia and Sweden. Further, in consequence of the occurrence of three different sets of black shales or slates, the Utica, the Niagara, and the Marcellus, among our stratified and fossiliferous rocks in different parts of the Province, and the outcrops of these extending in the direction of their strike, to great distances through the country, it has been hastily but erroneously assumed by many, that coal existed in Canada, and every now and then, when some one came upon the outcrop of some of these black shales, a hue and cry was raised that coal had been actually found. Now, one great practical good that our Geological Survey has done, is, that it has furnished materials which, dispassionately considered, will disabuse every mind, capableof national conviction of this error. The position of the coal formation in the Geologic scale has been well and accurately ascertained by observation and experience in all other countries where it occurs, and has been universally found to be above the Devonian or old red sandstone formation, and that again to be above the Silurian. Now, our Geological Survey has shown most conclusively, from the contained fossils of our rocks, which furnish an unerring index to the several formations, that all our stratified and fossiliferous rocks in the Western part of Canada, which are remarkably undisturbed, are Silurian,—and that in the extreme Eastern part of the Province, where they approach the New Brunswick coal field, they do not rise above the Devonian. Further, when the stratified rocks of Western Canada are followed into the neighbouring States in the direction of their dip, they are clearly seen to run under the Devonian rocks of Southern New York, and Northern Pennsylvania and Ohio, as well as Michigan to the Westward, and these again in their turn are seen to run under the coal formation, which thus occurs in that part of the Geologic scale where a well informed Geologist would naturally expect to find it. The results of our Geological Survey are such as should, at once and forever, settle all doubts in regard to this matter. It has been most indisputably proved that there is no coal in Canada, we may be all sorry that it is so, but being so, the knowledge of that fact, which our Geological Survey has established, may prevent many from ruining themselves by expending large sums of money in mining for coal where it will never be found. It has been well attested by men eminently qualified to judge, that, previously to the Geological examination of Britain and the State of New York, more money was lost in fruitlessly mining for coal where none existed, than would have paid many times over for the Geological Survey of these countries. If then, this needless expenditure be saved to Canada, it will be found in the end, that, in regard to this one matter, the Geological Survey has been practically a gain to the country. Moreover, in order to give a correct display upon a Map of the Geographical distribution of the various rocks and useful minerals, the Geological corps have found it necessary to Survey Geographically or rather topographically, as well as Geologically, and thus they have very largely contributed the materials for the construction of a more correct Map of Canada than has ever yet been published.

108. What do you think are the prospects for the future of the benefits, both scientific and economic, to be expected from it?—*Ans.* When it is considered how vast a territory the Survey has been spread over, in order to satisfy the public mind with a general view of the Geological structure and mineral products of the country, it will be easily understood that, when further time and increased means have enabled the Geological corps to make a more thorough examination of every part of the Province in detail, the past advantages and success of the Survey will be an earnest of the future, both in a scientific and economic point of view. Struc-

tural difficulties at various points will be better understood,—a better collection of fossils and minerals will be made, and new ones may be discovered, all tending to increase the light of Geological science,—many more localities abounding in minerals of economic value will be explored and brought under public notice, and a more correct and complete Map of the Province furnished. It is of the utmost importance, then, that increased means should be placed at Mr. Logan's disposal to enable him to attain these ends as fully and as speedily as possible.

109. What manner would you recommend of publishing the information hitherto obtained ?—*Ans.* Nothing could be more excellent of their kind than the Annual Reports of Progress already published, and where persons have been fortunate enough to obtain and preserve complete sets of them, they will find in them, as a whole, a very satisfactory display of the information hitherto obtained, although the information on various points is necessarily very much scattered through the several Reports from year to year. But unfortunately the number of these Reports heretofore published has been very limited, and those of any one year have seldom fallen into the same hands as those of any former year, while of the first one, which was one of the very best of them, and in its general description of the Geology of the whole Province, contained the key to the whole, so very few were printed that it is quite impossible to obtain it now. And where single Reports are in the hands of different individuals, however excellent they may be as Reports of Progress for a particular year, they necessarily give to the individuals possessing them but a very limited and unconnected view of the Geology of the Province as a whole. To meet the felt and growing want for fuller information, it has been sometimes proposed to republish the whole of these Annual Reports, just as they stand in one volume ; and it may be mentioned, that such is the appreciation of their value in the State of New York that it has even been proposed to republish them there. Instead of this, however, I would rather recommend that, in anticipation of the complete and final Report which Mr. Logan contemplates at the close of the Survey, there should be published as soon as possible a general Report of moderate extent, compiled and condensed from the whole of the Annual Reports up to the present time. This Report need not of course be so bulky as the whole of the Annual Reports taken together, and when the whole of the information scattered throughout these, in regard to each particular rock and each particular useful mineral, is brought together under one head, a much more connected and satisfactory view of the Geology of the Province would be given. I would also recommend that it should be accompanied by a coloured Geological Map of the Province, of convenient size, and a few sections. It should also contain woodcuts of all the most characteristic fossils of the several groups of rocks, and a few of the most common chrystalline forms of minerals. And finally, I would recommend that such a number of copies should be published as to make it accessible to all, who wish to make themselves acquainted with the Geology of the Province.

110. What number of the revised Reports would you advise to be published ?—*Ans.* From what I know of the interest awakened by the Annual Reports, and the growing desire throughout the Province to see them : I would advise that not less than ten thousand (10,000) copies in each language should be published. The more the better ; in fact you could hardly err in publishing too many.

111. How would you recommend them to be distributed ?—*Ans.* Over and above the general and promiscuous distribution of them in all the Counties, Cities, and Towns of the Province through their Representatives in Parliament, as at present, I would recommend that all Colleges, Academies, County Grammar Schools, Mechanics' Institutes, Literary and Scientific Societies, Public Institutions of every

description, all Public Libraries in Towns, Counties, and Townships, Municipal Councils, &c., &c., should be liberally supplied with them.

112. Would you advise that they should all be given gratuitously, or that some portion should be sold at the cost of printing?—*Ans.* The distribution indicated in my former answer might be gratuitous. But I think that at least a portion might be sold at the cost of printing; and I feel certain that they would be most cheerfully purchased at that rate, by very many who had not otherwise an opportunity of obtaining copies for their own use.

113. Do you think any great advantage would result from a large distribution of them?—*Ans.* I think it would be unquestionably of great advantage to distribute them largely. There is as yet no other way in which a knowledge of the Geology of Canada can be obtained by general readers; and it is of no small importance that the public mind should be well informed in regard to a matter so intimately connected with the prosperity of the Province. On the part of many, there is still no small amount of ignorance and prejudice, in regard to this matter, which may be dispelled by a wider diffusion of sound and correct information with a work, such as is contemplated in the hands of our people throughout the country,—the coloured Map and sections giving them some idea of the particular rock formation of their immediate neighbourhood and its connection with others, and the engravings of fossils and chrystalline forms, enabling them to recognize these in the rocks around them, and to identify them thereby; there is no doubt but that a deeper interest will be felt in Geology, and consequently observers and explorers will be multiplied, and interesting and important informations in regard to fossils and minerals may be supplied from many a nook and corner, that in such a widely extended country (and much of it still under forest,) might otherwise remain unnoticed. Besides, a wide distribution of this Report might in many cases, bring it under the notice of persons in other countries, possessed of wealth or skill, who might be attracted by the resources of the country and become valuable settlers, assisting by their wealth or their skill in developing these resources.

114. Do you think from your own experience that there is a growing taste for Geological studies, and an appreciation of the advantages to be gained from them?—*Ans.* Yes. Nothing is plainer to me from my own experience, than the fact that there is a gradual breaking down of the prejudices which have been entertained in regard to Geology; and amongst the whole circle of my friends and acquaintances throughout the Province, I have marked a growing desire for information in regard to it, as well as a growing conviction, that there is a definite and orderly arrangement of the rocks, and that it is only in certain rocks that certain useful minerals are to be obtained,—in short that it is science, that points the way. This is especially the case among the young men of the generation fast coming into public life; I see it in the increased love there is for Geological reading generally; I see it in the incipient collections of fossils and minerals, I occasionally meet with through the country, and I see it in the frequent visits I receive for the purpose of seeing and studying my own collection. And this leads me to remark that were, the means furnished for the Provincial collection of fossils and minerals already made during the Geological Survey being properly exhibited in the museum, this would have the happiest effects in not only assisting and cherishing the study of scientific Geology, but also in convincing even the most casual observer as to the actual resources of the Province. And while the Survey is going on and there is an opportunity for collecting extensively, I would recommend that, as a means of extensively cherishing this taste, provision should be made for furnishing to each of the Colleges as complete a collection of fossils and minerals as possible. This has been done in some of the neighbouring States, and

the advantages of it to the young men attending the Institutions, and through them to the country at large, is sufficiently obvious. I understood that, in addition to the usual Reports of Progress, it is in contemplation, hereafter, to publish annually a set of plates of the latest discovered and most striking fossils, with letter press descriptions: and I would most cordially recommend the proposed plan to the favourable consideration of the Committee, as an additional means of fostering the love of Geological study, and exciting a spirit of scientific investigation.

115. What number of the illustrative plates would you recommend to be published, and how would you distribute them?—*Ans.* I would distribute them on the same plan as the condensed general Report on the Geology of the Province; but not altogether to the same extent. For instance, the gratuitous distribution might extend to Colleges, Academies, County Grammar Schools, Mechanics institutes, Literary and Scientific Societies, and all the principal public Libraries, and the remainder might be sold at cost. In this way, as I suppose there would not be the same extensive demand for these as for the general Reports, perhaps two or three thousand copies would be enough.

116. Do you think any advantage would arise from the Geological Survey being in communication with private observers in different parts of the Province, and what means of effecting this would you recommend?—*Ans.* I think there can be no doubt as to the advantage. There is already a considerable number of well accomplished Geologists in the Province, with most, if not all, of whom Mr. Logan is already in communication. What seems to be wanted is some systematic arrangement in order more fully to secure the bringing together of all information obtained, in a more regular way into one common focus and to bring about opportunities for intercourse and discussion. For these ends I would recommend the formation of a Geological Society, similar to those in Britain and the neighbouring States. A considerable portion of its business might be done in the way of correspondence; but there ought to be a yearly meeting of members from all parts of the Province, and, upon the same plan as the meetings of the British Association for the advancement of Science at the different principal cities in rotation, or, (what would be an excellent plan,) at the same time and place as the meeting of the Legislature, and it ought to be aided by a Legislative grant.

[*Witness withdrew.*]

The Reverend Professor *Horan*, of Quebec, examined:

117. Are you Professor of Geology and Mineralogy in the Seminary of Quebec?—*Ans.* I have occupied that position for some years.

118. Are you acquainted with the reports of the Provincial Geological Survey?—*Ans.* I am, and my impression is that their importance entitles them to the attention of all persons desirous of obtaining a knowledge of the Geology of Canada.

119. Do you think the Survey has had important results in a scientific point of view?—*Ans.* In my opinion the Survey has had extremely important results in a scientific point of view. By the labors of the commission the age of the rocks of Canada has been made known;—it has been proved that they are all older than the carboniferous,—thus putting an end to fruitless searches after coal. These rocks have now been traced over a very large portion of the Province, and facts have been elicited tending to establish the existence of a shore to a Lower Silurian Sea of vast extent. Then the presence of phosphate of lime in the remains of Lingula, is a new fact never before revealed, and which does away entirely with former

distinctions between the skeletons of vertebrate and invertebrate animals. Several new minerals have been discovered, analysed and described; These results with very many others are highly interesting, important to Geological science, and cannot fail to reflect credit on the Province.

120. Do you think the Survey has made known facts of general utility?—*Ans.* By reference to a catalogue of the economic materials and deposits of Canada, published by the Provincial Geologist, and appended to the report of progress for 1850-51, it will be easily perceived that the Survey has proved beneficial in an economic point of view. Previous to the publication of the Reports it was impossible to know anything of the mineral riches, &c., of the country. At the present moment there are, if I mistake not, before the House two Bills to incorporate Companies formed to work Slate quarries in the Eastern townships; Now, previous to the Survey. The existence, or at least the value of these quarries was utterly unknown, the existence of soap-stone, ochres, &c., has been published, and in some localities lime has been shown to be at the door of many who heretofore sent to great distances to obtain it.

121. Has the information obtained by the Survey been of use to you as a teacher of Geology?—*Ans.* In teaching Geology the information obtained by the Survey has been of very great use by furnishing on many points illustrations, without which it is next to impossible to impart a knowledge of the science. Heretofore teachers have been forced to seek those illustrations in European works, &c.; a mode of instruction which must always take from the interest and utility of the study. I must state, however, that as yet we are debarred from the principal benefits resulting from the Geological Survey, and we must remain so until such time as the collections are put in order and laid open to inspection.

222. Do you think it important that the information contained in the Reports should be republished in a revised form; and what kind of revision and rearrangement would you recommend?—*Ans.* To me it would seem advisable that the information contained in the Reports, with whatever other matter might prove interesting should be condensed and republished, together with a Geological Map of the Province. This Map should be so drawn up and coloured as to convey at a glance a knowledge of the different formations and localities of the most important economic materials, represented by symbols in the ordinary way without this Map. I should think it next to impossible to give of the mineral productions of the country, such a view, as any one, wishing to enter on a speculation ought reasonably to desire. Moreover, as the nature of the soil generally depends on the accompanying rocks, another advantage to be derived from a Geological Map would be to give a knowledge of the agricultural capabilities of any given tract of country, and thus throw much light upon the principles of an enlightened culture. The condensed Reports ought to be divided into two parts, the one giving a description of the formations, illustrated by a few plates of the principal characteristic fossils; the other devoted to their economic materials. It would appear to me that it is very important that the republication should begin at once: and as there are many new scientific facts, which have been brought to light by the labors of the Commission, facts which may possibly be made known by others if the publication be delayed, the work should be brought out in parts as soon as ready, so that the credit may be given where it is due, and the Province may derive honor for its efforts in favor of science and industry.

123. Do you think that any great advantage would arise from publishing the economic materials or sections of the country in a separate form?—*Ans.* I do not think that any benefit would be derived from publishing them in a separate form as an enlarged and correct view of the value of economic materials could not be

us conveyed, and no enlightened person will be inclined, whilst seeking to become acquainted with the economic portion, to overlook that which appertains to the scientific part of Geology, since this alone can furnish him with a safe guide to conduct him in his researches.

124. Do you think that a good index both of places and materials would be a useful addition to the republished Reports ?—*Ans.* A good and complete index both of places and materials would certainly enhance the value of the publication, and increase its usefulness. It would give the means of seeing at a glance the contents of the work, and would also save much time in cases of reference.

125. What extent of demand for such a publication do you think there would be within the Province?—*Ans.* I should think that 10 or 12,000 copies would be as small a number as could be printed. It might perhaps be desirable to publish a much larger number, for although they may not be required within the Province, such a work will eagerly be sought after in foreign countries.

126. Do you not think scientific investigations should go hand in hand with, and are a necessary foundation for practical economic information ?—*Ans.* Such is the universally received opinion throughout all the countries of Europe, and the efforts now making in England and France in this direction show, that these countries are fully alive to the importance of science in its relations to practice. Science and practice are mutual aids ; and practice, when unaccompanied by science, is mere empiricism, and is a fruitfull source of error. It is only by science with practice that a country can improve its resources. Thus, for example, by a Geological Survey, the structure of a country is made known, a guide is given to conduct the engineer in his labors, new sources of mineral and agricultural wealth are developed, and (a very important point not to be obtained without scientific investigation) a wrong expenditure of capital is prevented. How many thousands of pounds might have been saved, what a vast amount of expense and labor might have been avoided, had the men who, for example, searched for coal in England and in the neighboring State of New York, combined scientific with practical knowledge.

127. Do you think that in the future operations of the Survey it would be advantageous to enlarge the personel of the Department ?—*Ans.* On this point I cannot say much, not being acquainted with the present organization of the Department. It would seem to me a false economy to refuse the Chief of the Department any thing which might contribute to render the working of his Department more effective. I may here remark that if, as mentioned in my answer to question 122, we have been hitherto prevented from receiving all the benefit, which would arise from a study of the collection now in process of formation, it has been entirely due to the want of a sufficient number of competent persons to arrange and classify the specimens, and thus form a museum where the public might find amusement combined with instruction.

128. Do you think it would be advantageous to send a Geological and Mineralogical collection to theParis Exhibition ?—*Ans.* Such a step would be decidedly advantageous, for it would be the means of making our mineral resources better known, provided proper and competent persons were selected and sent to explain it. On this selection, in my opinion, depend entirely the good results we ought to expect in sending such a collection.

(*Witness withdrew.*)

The Honorable *William Badgley*, of the City of Montreal, Examined:

129. Can you give the Committee any information with respect to the Geological Department of the Province?—*Ans.* I know little, personally, of the Department, except that Mr. Logan appears to be indefatigable in collecting information for it, and at all times affording most patient and kind attention and assistance to enquirers in Geological pursuits. As to the service itself, I have always considered it of primary importance, that the country should be informed of the mineral wealth which it possesses, and that the localities in which that wealth is deposited, should be fully made known. Several instances have come under my own observation, in which the Reports published by Mr. Logan have led to, as well as facilitated the establishment of mineral manufactures in this Province. For instance, the Slate formation in Kingsey, which is under manufacture, was originally obtained by a reference to those Reports, and affords not only an extensive home supply, but may be made to furnish an article of export. The quarry at this establishment has an opened face of slate, of over 300 feet in length, by two ledges, steps of over 20 feet each, from which the slate is taken and prepared for market; and a tram road of about five miles in length, connecting the quarry with the Portland Railroad, will shortly be in operation, at a cost of construction of £8,000 currency. The Townships in the neighbourhood of Kingsey shew similar slate deposits and serpentine, and a variety of marble for building, and other economical purposes, are opened out from time to time. Application was not long ago made, to load back to Barbadoes from Portland, with Kingsey slate, by a large vessel which had landed a cargo of sugar, but the home consumption required all the slates that could be made at the time. Steatite or soap stone, which is largely manufactured in the United States into furnaces, tanks, cisterns, stoves, coffins, and a variety of other purposes requiring a material capable of resisting heat without decomposition, and impervious to moisture, has also been pointed out by the Reports, and enterprise has been directed to its manufacture. A variety of other minerals and deposits are constantly exposed by the effect of Mr. Logan's survey, and would, no doubt, be greatly increased in number, if the Reports could be re-published for extensive circulation at a small expense. Frequent applications have been made to me for copies of the Reports, but they were not to be procured. I will only add, that parties from the United States have been induced to purchase mineral rights in this Province from their discovery in the perusal of the Reports.

(*Witness withdrew.*)

Mr. *John Lovell*, of the City of Montreal, Examined.

130. Do you print the Sessional printing of the House of Assembly?—*Ans.* I do.

131. Have you printed Mr. Logan's Reports of the Geological Survey?—*Ans.* Yes,—I have always printed them from the commencement.

132. Is there much demand for them beyond the quantity which is ordered by the House?—*Ans.* Yes,—I have had applications for them constantly, and have generally, in addition to the number ordered by the House, printed an extra 50 copies for myself, which I have distributed gratuitously, and also 250 copies for Mr. Logan, which were charged to his private account.

133. If a revised and condensed edition of former Reports were published, do you think there would be much demand for them on the part of the public at large?—*Ans.* I have no doubt of it whatever. I could have disposed of several hundred copies of each Report if I had printed them for myself. I do not doubt

that, if these Reports were advertised for sale, a large number might be sold. Gentlemen from the United States are continually applying to me for copies, and I have in several instances, through the kindness of Mr. Logan and others, been able to furnish applicants with a complete set.

134. What number of copies do you think would be required for general distribution?—*Ans.* If it is intended to make a general circulation of the work, I should say at least 10,000.

[*Witness withdrew.*]

Count *de Rottermund* of Quebec; Examined:—

135. Are you acquainted with Mr. Logan's Reports?—I have read several of Mr. Logan's Reports, printed by order of the Legislative Assembly, under the name of Geological Survey of Canada.

136. From your acquaintance with them, what is your opinion of their accuracy and importance?—*Ans.* My opinion of their accuracy is the same as might be entertained by any other person who has the pleasure of knowing Mr. Logan, that is to say, that that scientific gentleman could only have described what he was enabled to see or know. With respect to the importance of what is published by his Department, it is, or may be useful as general information in certain cases, especially that part of it which is signed by Mr. Logan and Mr. Murray.

137. Are there any theoretical conclusions expressed in them, from which you dissent?—*Ans.* I am of a different opinion as to the formation, position and importance of the mines, the information about them, and descriptions, especially of the auriferous mines, published from 1847 to 1854. These descriptions, are, in my opinion, very prejudicial to the interests of the Country. They are deficient in positive information which, from the repeated observations made in every year for a long time past, and mentioned in each of the Annual Reports, should have been produced, a description more in accordance with what the importance of the mines requires, both as regards the position of the so called mineral sediments, if they be sediments, and the cause why that metal should be so capriciously scattered over so considerable an extent of country; if it is so scattered, and if it is in lodes or veins, its position should have been traced. But to say every year, since 1847, only that there is none worth speaking of, hardly visible with the help of the microscope; and in other parts of his Report that there are 10,000 square miles of auriferous land, requires a more detailed explanation, as to the nature of that description of mines, than a mere enumeration and summary of the ideas of authors, with regard to parts of the country of small importance as regards auriferous land. This method of publication is only calculated to throw discredit and ridicule on the subject, as even the words prove which Mr. Logan makes use of in the Reports of 1854, "gold-hunters," for instance.

138. Do you consider the facts stated in them, with respect to Minera Deposits, to be correct, as far as they have come under your observation?—*Ans.* My opinion is different with respect to the position, formation and import ance of auriferous mines.

139. Do you think there are imperfections in the Reports, from omissions to describe what is to be found, or do you think that any section of the country is improperly described, so as to lead to the supposition that it does contain what does not exist there, or does not contain what has been or may be found there?—*Ans.* I do not think, that that could have happened as a voluntary omission,

knowing privately the means which Mr. Logan had at his disposal; that is to say, the Geological Department with the organization as it exists. He has described, in his Reports, almost all the Territory of the two Canadas. Moreover, he has been on several Commissions of Navigation, Exhibitions, &c., and taking into account that the whole works of exploration last only four months in the year, including bad weather, there is rather cause for surprise, that the short time at his disposal should have allowed him to pass so much in review; still more that he should have found means to make even a slightly superficial examination. It is impossible, with an organization such as at present exists, to expect any other kind of Report.

140. Do you think that it would be of advantage to the country, to publish, in a corrected form, the information already obtained by re-publishing the substance of Mr. Logan's Reports, together with maps, sections and other illustrations?—*Ans.* Whatever may be my personal opinion, or that of any other man of science, I believe that the works which Mr. Logan is desirous of publishing as his own, are worthy of publication; and particularly, with respect to maps, they would be highly useful to the country and to science.

141. Can you name any particular part of the country which would be injuriously affected by the publication of the Reports?—*Ans.* I believe that the opinion so often repeated, particulary with reference to the mines of Lower Canada, may prejudice Foreign Capitalists, and so destroy confidence in the working of the mines of Canada, and expose the people of the country who undertake to work them, to great and protracted struggles, without protection or assistance of any kind. On the contrary, they may have to contend against vague information, published under the sanction of Government; for this kind of description by no means gives information, which may aid in opening the works of the Mines, but creates sufficient excitement, to entail ruin by the great confidence which it inspires or by the premature discouragement consequent upon failure.

142. Can you name any particular facts or conclusions in the Reports, the publication of which, would have an injurious tendency?—*Ans.* I am not sufficiently acquainted with the wealth of Upper Canada, but as to Lower Canada, I am convinced that these Reports are injurious to the mining interests. Lime, marble and other workings of rocks, known as ordinary quarries will sustain no detriment nor receive any marked encouragement; but the publication on the subject of the auriferous soils, of platinum, of copper, of the chromate of iron, &c., as they are described in this Report, cannot in any way facilitate the prosecution of the works; on the contrary, it takes away all confidence from those who are in the habit of employing their Capital in mines; for the first impression produced by a pretended investigation, ending in disappointment, strikes for many years with a kind of ostracisme, and consequently the interests of the Country suffer to a great extent as, well as the credit of the Companies, and that of private individuals: instances of this are the copper mines of Leeds and gold mines at various places. But at the same time, I must observe that I am very far from blaming the author of the report, as I know, that being quite alone, he could not devote the whole of his time to his Geological labours, properly so called, and at the same time to the mines, to the navigation of the Lakes, Exhibitions, and a thousand other occupations to which he has been appointed.

143. Were you directed to those parts of the Country where you are engaged in mining operations, from information gathered through Mr. Logan's Report?—*Ans.* As long since as the year 1844, I gave my opinion of the richness of the minneral ores to be found in the Country; and in 1845, before Mr. Logan visited the

various auriferous mines of Canada, and before the discovery of gold and the diggings in Calafornia and Australia, I induced the Honorable Judge Caron, late Speaker of the Legislative Council and several others, to search for gold in the District of Quebec. Then came my Report published in the *Annales des mines, etc., de France*, which was reviewed by the Commissions of whom were Mr. Elie de Beaumont, Senator and Director of mines, &c., and other eminent Chief Engineers. That Report confirmed by specimens of the whole formation which I carried with me to Europe, proves that the opinions of Mr. Logan as laid down in his Report, were of no service to me in the selection and acquisition of the auriferous lands for the St. Lawrence Company.

144. Do you think that a good Geological Survey is an essential preliminary, or a material aid, towards a successful search for minerals?—*Ans.* It is an undoubted fact that a good Geological exploration is very useful in the search after minerals.

145. Do you think that the study of fossils, and the publication of Reports and engravings connected with them, is necessary, in the examination of the country for mining purposes?—*Ans.* The search for fossils and their publication, although not one of the fundamental principles which guide us in a search for minerals, might, after a long series of researches and comparisons, lead to some more direct advantage.

146. Do you think that a continuation of the Geological Survey, would have a beneficial effect in an economic point of view?—*Ans.* Every species of investigation can be of advantage to the country, and particularly a well organized Geological Survey.

147. Would you recommend an increased grant for this purpose?—*Ans.* Countries like Canada, require a department entirely devoted to Geology and mines, organized on an extensive scale and permament footing, for if the department of the mines is well conducted, it will form, from the various raw products, a very considerable revenue for the Province, bring in a large emigration of labourers, capitalists and mechanics, and furnish new occupation for the youth of the country, who aim at being useful. For there are, in it, innumerable resources of wealth which are not improved and turned to account, and which might bear competition with those of our neighbours, and hold a very important place in comparison with theirs. Accordingly every grant of money applied to this purpose must be useful to the country.

148. Do you think the Department of Scientific Geology, and the Department of practical Mining should be kept distinct?—*Ans.* The Department of Geology and that of the Mines, ought to be, as in other countries, conducted by a Council, and not by a single individual, for it is difficult for one person to possess all necessary qualifications to enable him to judge of scientific and practical undertakings, with which he has no personal acquaintance.

149. What annual grant do you think would place a Mining Department on an efficient footing?—*Ans.* The persons whose business it will be to organize this department, will be able to furnish particular information which I cannot give, in the short interval you have allowed me to answer so many various questions.

150. What extent and what kind of information do you think, private individuals should be entitled to claim from the Mining Department, supposing one to be established, or from the general Geological Survey?—*Ans.* Every individual ought, without distinction, to be able to procure a Map of any part of the country

which he is desirous of having, with the formation, direction, and character of the rocks and minerals, and the analysis thereof, with their use and advantage, on the payment of a certain sum to cover the expenses of this kind of publication. Moreover, before offering the Crown Lands for sale, the Government ought to cause them to be examined, and if there are mines, to sell them as such, with their products, forming lots suitable for the working of the mines or for agricultural purposes. By this means, not only would the Government receive a great revenue, but at the same time many capitalists would find an immense advantage in making complete purchases, rather than to be liable to considerable expense in acquiring portions of land from various individuals, to be obliged to pay enormous prices, in order not to be cut short in following the direction of a vein, and to find themselves ruined at last by the excessive expenses.

151. Are you acquainted with the Chemical Reports of the Survey, and what is your opinion of their value?—*Ans.* Some years ago, I particularly examined the Chemical works presented to Mr. Logan by his Assistant for the years 1847 and 1848, and published in 1849. I even made some remarks on the worthlessness of his analysis, and having received an answer more polemical than scientific, I did not think proper again to notice works which are undeserving of any serious attention.

152. Do you think a Chemical Department is essential in a Geological Survey?—*Ans.* Chemistry is most essential in the Department of Mines, as to Geology alone, uncombined with any other pursuit, Chemistry is superfluous, for the Geologist is supposed to have sufficient general information, when he wishes, to describe the nature of rocks. As to the direction, the age or epoch of deposits, the nature of the fossils, for these he does not want chemistry. We judge of fossils, by the impress of their surfaces, and not by their chemical composition, while in the Department of the Mines it is important to know, not only the direction of the vein, the direction of the rocks containing the mineral, its quantity and the method of working it, but also the composition and proportion of all substances, whether metallic or not, the natural state of such matter, and of all that is found in combination with the mineral, to be worked.

153. Would you recommend the Geological Mining and Chemical Departments to be kept separate, or would you have all the Departments of the Survey under one general management?—*Ans.* The Department of Chemistry cannot be separated from that of the Mines; the Council of Directors of Mines and of Geology ought to be integral, for Geology and the Mines, although distinct and separate objects of study, ought to minister to each other. These three Departments ought to be united and placed under the direction of a Council, in order to ensure unity of action in all operations which require exact knowledge, and not superficial ideas, the gleaning, of cyclopœdias.

154. Can you suggest any alterations in the system hitherto pursued, or any addition to the present staff, which would in your opinion be of advantage?—*Ans.* In the present Department I see no officers, but those who are required for Geological pursuits, such are Mr. Logan and his Assistant, Mr. Murray. As regards a knowledge of Mines, such as the Country would require, as being of the highest importance to render the works undertaken, scientifically and practically, useful to the Country in the aggregate, I see no one.

155. Do you think it would be advisable to make a Geological and Mineralogical collection to send to the Paris Exhibition, and what means would you recommend for forming such a collection?—*Ans.* Canada having received from

France numerous gifts at various times, it seems to me incumbent on the Province, on many accounts, to exert itself to the utmost, to contribute liberally to the General Exhibition. Having no scientific works of note to present, it ought to feel more than common interest in making the most of all its natural products, particularly those of the Mines. In support of the opinion which I now submit to the Honorable the Committee of the Legislative Assembly, I shall communicate to them an extract from a letter which I have received, written by order of His Imperial Highness Prince Napoleon, who is likewise President of the General Exhibition.

" His Imperial Highness regrets extremely that his departure, now near at " hand, does not permit him to attend throughout the several departments to which " it belongs, to the repairing of the losses which Canadians has to deplore. " He hopes that you will rightly appreciate all the cases and subjects of consi- " deration necessarily imposed upon him by the preparations for such a voyage. " In any other circumstances the Prince would have been happy to give to the " Government of Canada a proof of his readiness and anxious desire to do some- " thing to merit its esteem. His Imperial Highness requests that you will be the " bearer of this assurance, and believe, &c., &c., &c."

His Imperial Majesty and the Institute of France, are moreover desirous of contributing their aid by various presents of works useful to the Country.

I consider then that the House has a most favorable opportunity of testifying its sentiments towards the Country which has behaved so generously to Canada. With reference to the collection of Minerals, my advice would be to require the Geological Department to furnish all that it can, indicating the place where each specimen was found, accompanying all by a Geographical Map if no Geological Chart can as yet be had, and enriching the collection by the acquisition of all the specimens which the several Mining Companies can furnish respectively.

[*Witness withdrew.*]

The Committee adjourned to the call of the Chair.

Samuel Sleeper, Esquire, of Stanstead, C. E., Examined :—

156. I believe you are connected with the Quebec and St. Francis Mining Company ?—*Ans.* I am a Stockholder in the Quebec and St. Francis Mining Company.

157. Are you acquainted with Mr. Logan's Reports of his Survey ?—*Ans.* I have read Mr. Logan's Reports with care, but have not seen that number relating to the Survey of 1853.

158. What is your opinion of the value of those Reports ?—*Ans.* I consider those Reports of great value, inasmuch as they indicate to the Mining Engineer, the localities in which he may hope for success in his search for valuable metalliferous deposits.

159. Do you think them of sufficient value to justify their being republished for general distribution ?—*Ans.* Those Reports appear to me of sufficient importance to justify their being republished. At the same time, in order to prepare them for general distribution, it would be advisable to have them revised and condensed under the supervision of Mr. Logan.

160. Do you think that a Geological Chart as far its details are as yet known, should be published at the same time?—*Ans.* It would be of great service to the scientific enquirer, as well as to the general reader, if a colored Geological Chart say 24 in.) were appended to the volume of republished Reports.

161. With what part of the country are you best acquainted?—*Ans.* My explorations for minerals have been mainly in the County of Megantic, and I have some knowledge of the Counties of Sherbrooke and Stanstead, and the valley of the River St. Maurice and of the Chaudière.

162. Do you think the study of Geology useful in Mining operations?—*Ans.* The study of Geology is of great value to the Mining Engineer, as it is now well known that certain metalliferous deposits, sufficiently extensive to be valuable, can be found only in certain geological formations.

163. Have you yourself derived any advantage in your Mining operations from the Geological Reports?—*Ans.* I have derived little or no advantage from Mr. Logan's Reports, as I had previously obtained the necessary information from other sources.

164. Do you think there are any serious omissions or any erroneous views theoretical or practical in Mr. Logan's Reports on your section of the Country?—*Ans.* There are omissions in Mr. Logan's Reports, but these have arisen from a hurried survey, for which he cannot be held accountable, as the Country under his intigation is too extensive to admit of minute examination within the time he has been engaged. I cannot venture an opinion as to the correctness or incorrectness of his theoretical views, but whether they are based on his own opinions, or on the opinions of others, they appear to me to be of little value to the practical miner.

165. Do you think it would be advantageous to institute a more detailed survey?—*Ans.* The advantages of a more detailed survey appear to me evident, from the fact, that it would be but completing a work, which has been systematically commenced.

166. How long have you been acquainted with the County of Megantic, and from your knowledge of that part of the Country what do you think would be the expense of obtaining an effective knowledge of the Geology of that County alone?—*Ans.* My exploration of Megantic has been carried on during the greater part of three years; but having been principally engaged in searching for and tracing out deposits of ores, I am not prepared to make an estimate of the expense of obtaining an effective knowledge of the Geology of that County.

167. Do you think there is anything in Mr. Logan's Reports which would render their publication detrimental to the interests of the Country?—*Ans.* Mr. Logan's Reports, however deficient they may be, from causes above stated, are very beneficial to the Country, and they will probably be more highly valued in future than they are at present.

168. What is your opinion of the importance of the Mineral products of Canada?—*Ans.* The Mineral wealth of Canada is in my opinion very great, and it will doubtless well repay the capitalist and the skilled laborer whenever their energies shall be properly directed to its development.

169. Do you think that there has been much done hitherto towards rendering our Mineral wealth productive?—*Ans.* Very little has as yet been done to render our Mineral wealth productive. This is owing to the difficulties which are always experienced in a new Country where mining is not understood. Losses,

through needless expenditure, are incurred before mines can be brought into profitable operation, and this operates as a serious check to men of capital and enterprise.

170. Can you mention any of our Mineral products which are now being successfully worked or which are likely to be worked soon?—*Ans.* Iron ore appears to be almost the only mineral which has been successfully worked. Some of the ochres have been brought into use. Several copper mines have been opened, and probably within a few years there will be in successful operation mines of copper, lead, zinc, and perhaps silver and gold. These are found at present most extensive on the North Shore of Lakes Superior and Huron, between Bytown and Kingston, in the County of Megantic, and in the valley of the Chaudière.

171. Can you give the Committee any other information connected with the subject of their enquiries?—*Ans.* Other information, which I might feel disposed to lay before the Committee, has been acquired in connexion with a private Company, and its communication, at present, in a detailed form, might be held to be prejudicial to our interests.

[*Witness withdrew.*]

Wednesday, 10*th November*, 1854.

MEMBERS PRESENT:

JOHN LANGTON, Esquire, (Chairman.)

Mr. Bell,
Mr. Rhodes,
Mr. Valois,
Mr. Fergusson.

The Chairman laid before the Committee an account from Mr. *De Rottermund* for payment as a witness before the Committee amounting to £76—but it was not thought necessary to take any action in the matter.

On motion of Mr. *Bell* seconded by Mr. *Valois*, it was

Ordered,—That it being impossible for the Committee to Report to the House for some weeks, in consequence of the great length of the evidence (which is not yet completed,) the Chairman be instructed in the mean time to communicate with the Inspector General and inform him of the increased grant which the Committee are prepared to recommend.

That the following sums appear to be required annually, beyond the present appropriation of.....£2,000 0 0

For the publication of Fossils, Plates, Sections, &c.....	£500	0	0
To maintain the Museum and Library on an efficient footing.	250	0	0
For a resident Assistant in the Mineral business of the Department.....	200	0	0
For a Topographical Surveyor and his party during part of the year in each section of the Province.....	700	0	0
Additional Explorers.—Increase to some of the existing salaries, and Contingencies.....	350	0	0
Making in all an annual appropriation of	£4,000	0	0

Ordered,—That the Chairman communicate with L. Agassiz, Esquire, of Cambridge, State of New Haven, for information on the subject and the reference to the Committee.

The Committee adjourned to the call of the Chair.

T. S. Hunt, Esquire, of the Geological Commission of Canada, Examined.

1. What important scientific results have been developed by the Canadian Geological Survey?—*Ans.* I may in the first place allude to the investigations of the altered or metamorphic rocks, which are found in Lower Canada on the South side of the St. Lawrence. These rocks are a prolongation of the Green Mountains, and form the north eastern extremity of the Great Appallachian Chain, itself the most important Geographical and Geological feature of Eastern North America. These crystalline rocks, which are economically of great consequence from their mines of iron, chrome, lead, copper, and gold, and their beds of fine marbles, serpentines, soapstones, slates, &c., had been regarded by the American Geologists as primary strata, that is to say, more ancient than those oldest secondary rocks, in which are found the first vestiges of organic life. Although some few had ventured the opinion that they were really more recent strata in an altered state, the facts in support of such a novel proposition had not been brought forward, and the opinion of their primary character was still generally received.

It was reserved for Mr. Logan in his researches in the Eastern Townships of Canada in 1847 and 1848, to show that the Geology of that region furnished the key to a correct understanding of the age and Geological structure of the whole Appallachian Chain, and to demonstrate by a most minute and laborious investigation, that these so called primary rocks were really no other than the Silurian strata of the St. Lawrence valley in an altered condition. He has traced the gradual changes by which these fossiliferous sandstones and shales become the gneissoid, micaceous, and chloritic strata of the Green Mountains. In the course of this investigation, the results of the chemical examination of the unaltered strata were brought to bear upon the great question, and we were enable to shew that the chromium, the titanium, and the iron, whose compounds in a crystalline form were regarded as characteristic of some of these altered rocks, exist already in an amorphous condition in the unaltered strata.

As one result of this investigation may also be mentioned the determination of the true nature and origin of the serpentine of this formation. Serpentine is a magnesian mineral, which the highest authorities in the science have hitherto regarded as in all cases of igneous origin, and an intrusive rock like trap or granite. We have shown that in the Appallachian Chain, it is really a stratified rock of aqueous origin, and have actually assigned its true place in the Silurian strata. Our researches have moreover shown that the magnesia, which enters into the composition of the serpentine and its associated dolomites and talcose slates, was not introduced subsequently to the decomposition of the rock, as is supposed in the theory of von Buch, hitherto generally adopted, but that it formed a part of the original sedimentary deposit. This conclusion I regard as an important step towards a more simple and rational theory of mineral metamorphism, than the one hitherto received.

The establishment of the metamorphic nature and the true age of the crystaline rocks of Eastern North America, from the Gulf of the St Lawrence to the Gulf of Mexico, is the more important from the grand exemplification which it affords of the metamorphic theory. Hitherto, although the existence of such changes was considered probable, the cases in which the fact of alteration had been proved were but few, and confined to limited areas. Portions of the Alps of Savoy and Switzerland, and the marbles of Carrara in Italy, had been shown to be altered secondary strata, but most Geologists have hitherto been unwilling to accept the bold generalizations of Lyell, and extend a similar view to wide spread areas. The results of our Survey, which have shown the truth of this view as applied to a great portion of the Western Continent, have now placed the theory on an assured basis.

Another interesting investigation has been that of the Laurentides. This mountainous region, stretching from the Gulf west to Lake Huron, is composed of the oldest known rocks, not only of North America, but of the Globe. On this continent, they are so far as yet known confined to British America, except a prolongation into northen New York, and perhaps some exposures west of the Mississippi, while in the old world they have been recognized only in Scandinavia, Finland and northern Russia, and perhaps in the north of Scotland. These rocks have never hitherto been carefully investigated, and a partial examination in the state of New York, had led an American Geologist to regard them as of igneous origin, and to look upon the crystalline limestones and hypersthene rocks, with their associated iron ores, as alike intrusive. The researches of our Survey have shown that these antique portions of the earth's crust are, not less than the rocks of the Eastern Townships, metamorphic sedimentary deposits, and indicate the existence at the remote epoch of their formation, of Physical and Chemical conditions similar to those, which have accompanied all the succeeding Geological periods.

Mineralogically, the investigation of the so-called hypersthene rocks of this formation, with their peculiar calcareous triclinic feldspars, is of eminent scientific interest, while the fact, that the famous iron mines of Sweden, Russia, and those of Lake Champlain in the United States, belong to this series of rocks, gives them a great economic importance. The immense deposits of iron ore at Marmora, Madoc, South Sherbrooke, South Crosby, McNab, Hall, and elsewhere in the same region are contained in this formation. It is interesting as illustrating the connection between the geology and the agricultural capabilities of a district, to observe that wherever in the region of these Laurentian rocks the calcareous feldspars, above alluded to, are met with, their decay gives a fertile soil, strongly contrasting with the barrenness of those districts, where the more silicious portions of the formation prevail.

2. What results of economic importance have been obtained by the Canadian Survey?—*Ans.* The economic results of the geological exploration in developing the resources of the Province in iron, copper, peat, marbles, building stones, slates, and similar materials have probably been already pointed out to you. The value of such an exploration is often more directly felt, when employed in indicating supplies of those common materials which are the necessities of every day life, than when pointing out mines of precious ore, or quarries of costly marble. I have been struck with this when in several districts among the Laurentian rocks, I have been enabled to point out the existence of beds o limestone. Settlements in these hills have, for a reason above alluded to, generally followed the lines of the hypersthene rocks, which are associated with a white crystalline marble, yielding excellent lime, but so unlike in appearance to

the blue Silurian limestone of the flat Country, that those people who have built their houses upon it, often go many leagues to bring lime for the manufacture of potash, and for mortar. I had occasion some time since, while examining the townships of Rawdon and Chertsey, where the inhabitants brought all their lime from the vicinity of L'Industrie, to point out the existence of immense beds of fine crystalline limestone running through these townships, and affording a source of profit to these hardy settlers hitherto unsuspected.

In speaking of the ecomomic results of the Survey, the examinations of our mineral waters must not be forgotten. From their medicinal value mineral springs often become centres of attraction and of population; Bath and Harrowgate in England, the famous watering places of Germany, and those of Virginia and Saratoga in the United States among others, owe their importance to mineral springs. Canada abounds in mineral waters of almost every kind, and their investigation has occupied much of my time during several years. The Annual Report of Progress of the Geological Survey for 1853, contains a list of fifty-six springs, with references to the pages of that, and of previous reports, in which the analyses may be found. The number of mineral waters, whose composition is thus made known, is greater than that of all the others yet described in America, and the published results will show that, probably nowhere but in France and Germany, have the examinations been made with the same degree of minuteness as in Canada. A great proportion of the waters have been analyzed quantitatively.

Among the most remarkable of our mineral springs thus made known, are those which contain large portions of iodine and bromine salts, and others holding in solution salts of the rare bases baryta and strontia, which had hitherto been detected only in a few springs in Germany. We may also mention the numerous alkaline waters, remarkable for the great proportion of carbonate of soda which they contain, along with silicate, phosphate and borate of soda, or borax. This rare salt hitherto unknown in the waters of North America has been found in several springs in Lower Canada. The waters of Tuscarora, Chippawa, and St. Davids in Upper Canada, remarkable for containing large quantities of free sulphuric acid, with sulphuretted hydrogen and sulphates of alumina iron, and lime, may also be mentioned, and the sulphur spring of Charlotteville, near Simcoe C. W., surpassing in the amount of sulphuretted hydrogen the famous Harrowgate waters, is also worthy of especial notice, for it is destined at some future time to become an important watering-place. The results of these analyses have made known to the medical profession the Chemical composition of all these various waters, and will enable the enlightened physician to prescribe them with discrimination in the various forms of disease.

The study of these different springs has at the same time been made with especial reference of their geological position, and many curious and important relations between their soluble mineral contents, and the composition of the sedimentary rocks, have been shown, throwing light at the same time upon the theory of the formation of mineral waters, and the chemistry of the strata through which they flow.

3. How are the results of the Survey regarded in other Countries?—*Ans.* The results of the Survey so far as made public in the Annual Reports of Progress, are cited as authoritative throughout the scientific world. M. DeVerneuil has from time to time given abstracts of our most important results to the Geological Society of France, while the English Geologists, and especially those connected with the Geological Survey of Great Britain, have shown in many ways, both publicly and privately, their high appreciation of the results of the Canadian

Survey. Mr. Hall, whose opinion is law in American Geology, has probably already told you the light in which the Survey is regarded by the Geologists of the United States. I may mention moreover that the occasional memoirs upon subjects connected with Canadian Geology and Mineralogy prepared by Mr. Logan and myself, and published in the London Philosophical Magazine, and the American Journal of Science, are always re-published in Germany, frequently in full in the Centralblatt at Leipzig, and in the Jahresbericht, or Annual Report of the Progress of Chemistry, Mineralogy and Geology, edited by Liebig and Ropp at Giessen.

I may cite, in this connection, from an article on Silurian Geology in the London Quarterly Review for October, 1854, evidently from the pen of an accomplished Geologist, the following notice of the labors of the Canadian Survey. After alluding to the geological investigations in the United States, the writer says.

"In the mean time our own Transatlantic Government have not been neglectful of the good work of science. In Canada especially, there has been proceeding for some years, one of the most extensive and important Geological Surveys now going on in the world. The enthusiasm and disinterestedness of a thoroughly qualified and judicious observer, Mr. Logan, whose name will ever stand high in the roll of the votaries of his favorite science, have conferred upon this great work, a wide-spread fame."

Up to the present time, the results of the Survey have not been in that accessible form which could be wished, and the difficulty of searching them out from the Annual Reports, without the aid of a Geological map of the Province, is such that even those interested in the science are awaiting the publication of our results in a more available form.

4. What do you regard as the best mode of re-publishing the matter embodied in the different reports?—I am told that it has been proposed to publish, in a condensed form, the results embodied in all the Annual Reports up to this date, illustrated by sections, and by figures of the most characteristic fossils, and accompanied by a geological map of the Province. I regard such a plan as the best that can be adopted, both for the information of the scientific world abroad, and for the use of those who may wish to study the geology of their own vicinity. I conceive that in the latter way many may be incited to pursue the science as *amateurs* with profit to themselves, and may at the same time greatly advance our knowledge of the resources of the Country.

Letter from L. Agassiz, Esquire, of Cambridge, New Haven, to the Chairman of the Committee, dated 22nd, November, 1854.

Cambridge, November 22nd, 1854.

Dear Sir,—It is a rare privilege for a scientific man, to have an opportunity of presenting his views upon matters connected with his investigations, to men holding a position of trust in public affairs. But it would be quite unnecessary for me to go to Quebec, in order to answer fully your letter, as I have long been acquainted with the valuable results of Mr. Logan's investigations in the Geological Survey of Canada, the high scientific value of which, is fully appreciated wherever Geology is cultivated. I may therefore rely upon this acquaintance with the state of your Survey, to answer your questions.

I do not wonder that in Canada, as everywhere, the people complain of the scantiness of practical results from such Surveys. This arises partly from a want of appreciation of the necessities of the case, and partly also from the limited scope, and the inadequate means placed at the disposal of the Surveyors. The subject is so wide, and requires such diversified knowledge, that it is hardly fair to expect from a single individual, at best aided by a few assistants, the completion in a few years of all the investigations necesssarily connected with the Geological Survey of such extensive lands as the Canadas. To cover the whole ground, a Geological Survey of this kind, ought to be conducted by several heads, superintending different departments of investigation, since it is necessary to obtain first a general knowledge of the Geological character of the country, and next to carry out, upon the information thus obtained, the special investigations essential to practical operations. Allow me a comparison to explain more fully my meaning. Topographic Surveys, to be satisfactory, ought to be founed upon astronomical observations, but who would therefore expect that astronomers should leave their telescopes, go into the field, chain in hand, and draw maps. Mining operations bear to Geology the same relations, that geodesic operations bear to astronomy. All that may fairly be expected of a Geologist is to prepare a Geological map of the Province he surveys, and thus to obtain the information, without which the mineral resources of a country cannot be satisfactorily ascertained. But to derive practical advantages from such surveys, they must be carried out upon a more extensive plan, with special surveys of such tracts as are promising for profitable operations.

Now your Survey is so far advanced as to afford ample preliminary information, and the safest way to gratify the claims of your people for the final advantages to be derived from it, would be by adding to it a mining department.—Should you succeed in obtaining a sufficient appropriation from your Legislature thus to enlarge the Geological Survey, and, at the same time to publish in a systematic manner, the results already obtained, it is my opinion that special care should be taken to preserve all and every information collected by Mr. Logan. It is not generally understood how valuable such general Geological information is, in developing the resources of a country by pointing out the general physical features of the land, the nature of the subsoil, the range of the different kinds of rocks, the position of ores and mineral veins, the extent of coal-fields, &c., &c., all of which have a direct bearing upon agriculture and mining, though perhaps the connection is not immediately noticed. There is one point in particular, the utility of which is least understood, and yet of paramount importance in the eye of a Geologist,—the illustration of fossil remains, without a careful investigation of which, the Geologist himself is in most cases unable to determine with precision the succession and relative age of Geological formations in remote districts. Now the knowledge required for such studies upon fossils is rarely possessed by Geologists, who are at the same time sufficiently acquainted with their special department to carry on satisfactorily a Geological Survey, and it is generally found necessary to appoint a palæontologist besides a Geologist in the completion of such a survey. In the present state of our science, few men combine the necessary requirements for the double task. The training for each requires indeed special abilities, and even when in rare cases, the same man might be equal to the execution of the whole, the work would be too extensive to be performed in a single lifetime. That the work may be done *well*, the Geologist ought to have a topographic assistant and the palæontologist be supplied with a skilful artist. The task of the Geologist should be limited to the preparation of the map, the description of the rocks, their natural relations, &c., &c. The palæontologist should be exclusively occupied in comparing, describing and figuring the fossils, which

cannot be done without a knowledge of Zoology and comparative anatomy, sciences which are entirely unnecessary to the Geologist.

The mining engineer should make special Surveys of the mineral lands, sufficiently minute to be subservient to mining operations, which a general Geological survey never can be, though these special surveys cannot even be begun successfully, before the general Survey is sufficiently advanced. Finally the chemist should be confined to analyzing rocks, ores, minerals, waters, soils, &c., &c.,

Even with such a division of labor, the heads of the different departments would be found to have their hands full. They would even require numerous assistants, if the work is expected to proceed rapidly. If you enquire into the composition of the corps to which the Geological Surveys of France and England have been intrusted, you will perceive that the combined efforts of many of the best men of the age have been deemed necessary to bring the undertaking to a satisfactory conclusion.

There is one point more to which I would call your attention. I know from the reports of visitors competent to judge of such matters, that the value of the large collections brought together by the energy of Mr. Logan, is greatly impaired, and that the collections are rendered almost inaccessible to those who would derive great benefit from their examination, by being heaped together, as they are, without systematic arrangement.*

A Geological Museum scientifically arranged would not only be a source of invaluable information ; but also an ornament to your city, and, if founded, would set an example worthy of being followed throughout the whole continent North and South of the St. Lawrence.

I thank you for the good opinion you entertain of the value of my views. If a voice from the other side of the Atlantic, now almost Americanised, can have any special weight with your population for being French, allow me to add to my signature, the only title which, in the estimation of a Frenchman can give authority to the opinion of a scientific man, and to which on an occasion like this, I may be pardoned for alluding.

L. AGASSIZ,
Membre de l'Académie des science,
de l'Institut de France.

J. Langton, Esquire.
Quebec.

* That portion of the collection which is accessible to the public is systematically arranged as far as circumstances permit, but a very large portion of it, from want of room, of cases for displaying it and of time for arrangement, is still in packing cases in the vaults and sheds of the building,—*Chairman of Committee.*

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GEOLOGICAL SURVEY OF CANADA.

SIR W. E. LOGAN, F.R.S., DIRECTOR.

SUMMARY REPORT

OF PROGRESS IN

GEOLOGICAL INVESTIGATIONS

DATED 1ST MAY, 1869.

Printed by Order of Parliament.

OTTAWA:
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1869.

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SUMMARY REPORT

OF PROGRESS IN

GEOLOGICAL INVESTIGATIONS,

Dated 1st May, 1869.

GEOLOGICAL SURVEY OFFICE,
Montreal, 1st May, 1869.

To the Hon. H. L. LANGEVIN, C.B.,
Secretary of State,
OTTAWA, Ontario.

SIR,—The Survey instituted by the Government of Eastern and Western Canada for the geological examination of the area comprised within those two provinces, having by an Act passed last Session of Parliament, been extended to all the provinces of the Dominion, and the wider investigation having been commenced last summer, it becomes my duty to place before you, for the information of His Excellency the Governor General, a summary of the progress which has been made in the work.

The last report of progress of the Survey as previously constituted, was made in 1866. In the latter part of that year, and in 1867, much of my own attention, of that of Dr. T. Sterry Hunt, and other officers of the Survey, more particularly Mr. Richardson, was devoted to the collection, arrangement and illustration of a series of specimens contributed to the Paris Industrial Exhibition of the latter year, showing the mineral resources and geological structure of the country. These specimens were accompanied by a collection of the various publications of the Survey, including maps, sections and reports, with palæontological decades and memoirs, and Dr. Hunt, who was sent to Paris specially to explain the contribution, published in French, while there, a brochure, containing a sketch of the Geology of Canada, and an illustrated catalogue of the specimens. The whole collection was regarded with much attention by scientific men, and rewarded with the following prizes:—

Special grand bronze Medal (hors concours) equal to a gold medal.....	1
Silver medal.....	1
Bronze medals.....	4
Honorable mentions.....	5
Prizes.....	11

On the termination of the exhibition, a series of our rocks, valuable in a scientific point of view, and in which Mr. Daubrée of the Jardin des Plantes, took a special interest, was presented to that institution on behalf of the Survey.

In the latter part of 1867 Dr. Sterry Hunt and Mr. A. Michel, having been instructed to make a cursory general examination of the gold fields of Nova Scotia, with the view of instituting a comparison between the auriferous rocks of that province and of Canada, the Report resulting from the examination, having been specially called for, was transmitted to the Government and printed by order of the Legislature last session; but investigations in other parts have been carried on since 1866, and of these, and the work of last summer, I have now to furnish information.

During the last season and part of the previous one the labors of Mr. J. Richardson have been devoted to a detailed examination of the country on the south side of the St. Lawrence between the Rivers Chaudière and Du Loup, and spreading in breadth from the margin of the St. Lawrence to the boundary between the Province of Quebec and the United States, the object being, in continuation of his work above the Chaudière, to trace out the distribution of the Quebec group, one member of which, the Lauzon, is so valuable for its economic minerals. He has ascertained that in the middle of the area, and extending its whole length, there is a synclinal belt of the Sillery formation, varying in breadth from two to twelve miles, affected by several subordinate undulations, and presenting a ridge of broken country, much covered by forest, and little fitted for the purposes of agriculture. From beneath this on the south-east side there emerges the Lauzon formation, which accompanies the Sillery in its whole length, and displays a breadth one mile in some places and six in others, while it is followed by the black shales and limestones of the Lévis formation. The greatest breadth of this, at each end of the surface it underlies, is about seven miles, and from each end it narrows towards the intermediate part, for about twenty-five miles of which it becomes covered up by the succeeding unconformable Upper Silurian rocks, which here bound the Quebec group in the whole distance, with only a narrow strip of the Sillery and Lauzon, between these upper rocks and the Lévis in the more western part.

On the north-western side the Sillery is followed by the Lauzon only, in circumscribed and isolated portions, without the Lévis formation, the Sillery being in contact for the chief part of the distance with what is now supposed to be a lower and unconformable series of rocks. Like the rocks of the Quebec group, this lower series consists of red shales, black shales, limestones, sandstones and conglomerates having an arenaceous base and limestone pebbles. It was formerly classed as belonging to the Quebec group, and it is only on the evidence of fossils that it can be placed on a lower horizon. Some of the fossils are known Primordial species, and all have, in the opinion of Mr. Billings, an undoubted Primordial aspect; but the manner in which they occur does not at once produce a satisfactory conviction that they determine the age of the deposits. The fossils, with but few exceptions, are in the pebbles of the conglomerates which, though derived from the destruction of Primordial rocks, may possible not be in such now. The series seems almost to stand in the place of the Lévis, but the want of conformity shown by the contact with the Sillery, and the occurrence of a *Salterella* in an even bedded limestone, would seem to carry the preponderance of evidence the other way. Provisionally this series will be considered Primordial, and as belonging to the upper part of the Potsdam group. It consists, in ascending order, of the following divisions:

1. Red, green and black shales, surmounted by even bedded gray limestones, in which a species of *Salterella* occurs with black phosphatic nodules.
2. Grey sandstone with black shales, interstratified with conglomerates having a calcareo-arenaceous cement and holding limestone pebbles with occasional black phosphatic nodules. The limestone pebbles hold fossils of Primordial type.
3. Gray quartzose sandstones passing into quartzites, which are often of a conglomerate character, with limestone pebbles holding fossils like those in the previous division. The beds are occasionally interstratified with black shales.

These deposits present themselves between the Sillery ridge and the St. Lawrence in a belt of country extending the whole distance examined, with a breadth in one part of twelve miles. In this they are arranged in two main synclinal forms, with many minute undulations, and they are overlaid unconformably by two long synclinals of the Lauzon and Sillery, one of them with a stretch of sixty miles.

Although rocks of the age of the Quebec group thus continue in a north-eastern course down the valley of the St. Lawrence, they appear gradually to lose the magnesian deposits and accompanying metalliferous minerals, which to the southwest give them so much value. While the strike of the group is northeast, the limit at which the metalliferous indications in succession die out, seems to trend more to the eastward, in which direction it finally runs obliquely under the rim of the Upper Silurian series, and leaves the Lauzon barren of metalliferous ores in its prolongation beyond.

For the last three seasons the attention of Mr. H. G. Vennor, has been bestowed upon the investigation of various rocks which are spread out in the counties of Addington, Hastings and Peterboro, in the province of Ontario, and which have been more than once mentioned in previous reports. Their lithological characters and economic contents were given in some detail in the report of Mr. Thomas McFarlane for 1866. Ores of iron, lead, copper and antimony were then known to be found in them, and to these have since been added gold, silver and bismuth. After much research in tracing out the distribution of these rocks, Mr. Vennor has been able to determine the geological structure of the district and the stratigraphical relations of the iron and gold.

The series consists in descending order of the following general divisions:—

1. Calc-schists, dolomites, mica slates and siliceous slates, the latter two characterized by extensive lenticular masses of conglomerate with pebbles of quartzite, gneiss and greenstone, at the base of which there appears to be an auriferous band.
2. Hornblendic, pyroxenic and chloritic slates, characterized at the bottom by passing occasionally into beds of magnetic iron ore of commercial importance, and succeeded in some places by gray and red granitic gneiss, and hornblendic schist, interstratified with bands of crystalline limestone.
3. Syenitic rocks varying in color from flesh-red to brick-red, and forming the base on which the rocks appear to rest throughout the district.

This series lies in a general synclinal form between the counties of Addington and Peterboro, with a breadth of about thirty-five miles, which has been traced to the north-eastward from the position where it emerges from beneath the overlying Lower Silurian rocks on the south-west, to within half a mile of the York Branch of the Madawaska River, a

distance of about forty-five miles. Many subordinate undulations, striking to the north-east, and affected by transverse geological depressions and elevations, cause the distribution to assume a very complicated figure, presenting a number of basins in the upper division, more or less united with one another, the intricate outline of which can only be made intelligible by being represented on a map.

The iron ore beds of Belmont, Marmora and Madoc, which have often been separately described in previous reports, are found to be on the same horizon with one another, at the base of the upper division, while the localities in which gold has been discovered, appear to show an auriferous zone at a short distance above the iron belt, the separation between the two being seldom more than the breadth of half a lot, or between three and four acres.

The calc-schists are in one or two places marked by the presence of *Eozoon Canadense*, and anorthosite rocks have been found rising above the upper division in isolated masses; but from the difficulty of finding any marks of stratification in them, it can scarcely be decided whether or not they are conformable, and before the question whether the Hastings series belongs to the Upper or Lower Laurentian can be satisfactorily determined, further investigation will be required. Provisionally the series is classed with the Lower Laurentian.

The investigations of Mr. C. Robb embrace a region which is situated in the central and north-western part of New Brunswick, comprising chiefly the counties of York, Carleton and Victoria. In this he has traced the north-western base of the great Carboniferous area of the province for about seventy-five miles, as well as the boundaries of three extensive outliers of the Carboniferous series, one situated in the parishes of Prince William, Dumfries, and Queensberry in York County; another, which had not been noticed by any previous observer, in Brighton and Peel parishes in Carleton, and a third in the Tobique valley, in Victoria.

From beneath the Carboniferous rocks there emerges a series of contorted slates interstratified with bands of hard gray, bluish and greenish micaceous sandstones approaching quartzites. With these, in a north-easterly direction, there runs a belt from ten to fifteen miles wide, removed from five to fifteen miles from the main Carboniferous outcrop, and rudely parallel with it, which is characterized by the presence of granitic masses, the relations of which are obscure. The age of the contorted slates has been doubtful, but the discovery of thin fossiliferous bands in three localities at wide intervals across the strike, will be serviceable in throwing some light upon the subject. Mr. Robb has confirmed the discovery by visiting the localities where he obtained several of the fossils, among them *Chonetes Canadensis*, *Leptocœlia flabellites*, and an unnamed *Streptorynchus*, which all belong to that part of the Gaspé rocks, which have been described as forming a passage between the Upper Silurian and Devonian series; and there is also *Rensselœria ovoides*, a species of the same horizon. These were obtained at a distance of ten miles from the Carboniferous base, on the east side of the granitic belt. Twenty-seven miles farther, and on the west side of the belt, occurred a *Favosites* and some obscure brachiopods of an Upper Silurian aspect, while thirty-four miles still further across the stratification a thin band of limestone yielded an Upper Silurian form of *Atrypa reticularis*.

As much interest has recently been excited by the reported discoveries of gold-bearing rocks in New Brunswick, Mr. Robb visited some of the lands in Victoria county which had been leased for gold-mining purposes. He also visited and made special examination of those

localities within the general area designated, which have been supposed to be productive of other minerals of economic value, or in which mining operations had been instituted. Quartz veins, forming apparently lenticular masses and running in the strike, characterise the slates in many parts, and several in Victoria county were pointed out to Mr. Robb, as having yielded the precious metal. None of it was visible to the naked eye, and specimens of the quartz were therefore brought to the Survey Office for assay. They have been analysed by Dr. T. Sterry Hunt, but no gold has been found in them. This however is not to be taken as absolute proof of the absence of the precious metal in every part of these veins, for the distribution of gold in quartz is so capricious that of several specimens taken from the same vein, some may yield a fair quantity and others none at all. The slates in which most of the auriferous quartz occur in the Eastern Townships of Quebec, are classed as Upper Silurian, and they appear to have some resemblance to those of Victoria. The discovery of alluvial gold also in Victoria, asserted by several respectable persons is a farther evidence on the subject, though none of it rewarded the trials of Mr. Robb.

During several months of the season I availed myself of the services of Professor L. W. Bailey of the University of New Brunswick at Fredericton, and Mr. G. F. Matthew of St. John, in an exploration in southern New Brunswick. These gentlemen worked in unison, sometimes together and sometimes separately, but in the latter case always finally comparing results. The area of their investigation comprehended the western portion of the counties of St. John and Kings, and the greater part of the county of Charlotte, or geologically a metamorphic district included between the St. John and Nerepis Rivers, on the east, and the boundary of Maine on the west, extending north from the Bay of Fundy and several of its islands on the coast, towards the southern boundary of the great Carboniferous area of the Province.

This region appears to embrace a complicated distribution of rocks belonging to the Laurentian, Huronian, Lower Silurian, Upper Silurian, Devonian and Carboniferous eras, and when well studied out may, in a comparatively small area, afford the means of correlating different members of the whole series of formations in localities where each may be more extensively spread. Messrs. Bailey and Matthew have heretofore directed their efforts to the elucidation of this intricate region, but on this occasion they have carried their investigations into much greater detail. They have ascertained many new facts, which will serve to correct the results of previous partial explorations, and greatly advance a subject still far from complete.

In their investigations, Messrs. Bailey and Matthew did not fail to bestow careful attention upon the various economic substances which occur in the district examined. Those which are likely to prove available, are the ores of iron, lead and copper, with building stones, marbles, roofing slates, graphite and peat.

The attention of Mr. D. Honeyman was applied in Nova Scotia to an examination of various parts of the townships of Maxwelton, Arisaig and Antigonish in the counties of Pictou and Antigonish, especially those extending along the sea coast for a few miles inland, embracing rocks of the Silurian and Carboniferous eras. Belonging to the latter on both sides of Antigonish harbor, there are important deposits of gypsum, well situated for the purposes of trade, and the recent investigations of Mr. Honeyman appear to have considerably extended the surface under which the mineral was previously known to exist.

In Nova Scotia I availed myself also for a short time of the services of Professor H. How of King's College, Windsor, whose attention was directed to various parts of the County of Digby, where the ores of iron, with some indications of copper and lead, appear to be the chief substances of economic interest.

About three months of my own time have been occupied in the investigation of the structure of that part of the Pictou coal-field in Nova Scotia, which lies southward of New Glasgow, and extends several miles on each side of the East River. In this I was aided by Mr. E. Hartley, and with the view of hastening the examination as much as possible, we divided the work into two parts. That on the west side of the river was wholly committed to Mr. Hartley, that on the east was undertaken by myself.

The true structure of a coal field, in which valuable seams of the fuel exist, being a matter of great commercial importance, no pains should be spared in making it out; but where, as in the present instance, it is of a complicated character, while natural exposures and crop-workings are but few, it will demand much time to accumulate the number of facts required to arrive at a satisfactory conclusion. We do not pretend that in three months we have been able to accomplish our task, but it appears to me that we have added considerably to what was previously known, and at a future time we hope still further to advance the subject.

The New Glasgow productive coal measures appear to lie between two great up-throw faults, which are about three miles apart on the East River, and run nearly parallel to one another in a bearing northward of west. The coal field is about ten miles long between Middle and Sutherland Rivers, and it is broken by several obliquely transverse faults. The measures suffer some undulations, and in several parts the coal seams abut against one or the other of the bounding side fault.

On the west side of the East River, the principal coal bed, being the one on which are established the Albion, the Acadia, the Intercolonial and the Nova Scotia collieries, is called the main seam. It is about thirty-five feet thick at the first named colliery, and about twenty feet at the others. Beneath this there is a seam of twenty-four feet, one of five feet and one of eleven feet, all in a thickness of about 500 feet; besides which about 200 feet lower, there is a four-feet seam, made up partly of coal and partly of a species of carbonaceous shale, yielding much oil by distillation, and formerly giving it great value.

On the east side, besides an oil-shale seam of about four feet, on a different horizon however from the one just mentioned, there are among other coal seams of minor importance, one of four feet, one of six feet, and one of eight feet, all of good quality, with others of inferior quality but greater thickness beneath. The most important of the whole is the eight-feet seam, which, where exposed, is of excellent quality in its whole thickness. It has been only lately opened by Messrs. McBean on their three-mile area, much of which it will underlie; the crop of it, having already, since I left Nova Scotia, been traced three quarters of a mile, running obliquely transverse between the two great up-throw faults mentioned.

To elucidate the structure of this coal field, a map is in preparation, but not yet completed, and when transmitted to the Government, it will be accompanied by reports, giving such details of structure as we have been able to collect, and in which we shall take the opportunity of thanking many persons for the information and assistance they have afforded. The reports will be accompanied by an appendix, giving in a tabulated form, analyses of coals from

various seams of this field, some of the analyses recently made, and others collected from different official sources, not now readily accessible, as well as information which could not be conveniently introduced into the body of the reports.

From the various assistants whose works of exploration have been mentioned, reports have been received; but having only lately come into my hands it will require some time to study them thoroughly, and therefore be necessary to defer their presentation to a future occasion.

I have further to mention the investigations of Dr. T. Sterry Hunt, on which he is preparing a detailed report nearly complete. This will contain his investigations of the salt wells of Goderich and its vicinity, being a continuation of the details given in his report of 1866, with an account of the new wells sunk at Clinton and Kincardine, and analyses of the various brines; details on the making of salt in boilers as pursued at Goderich, and comparisons between the results obtained there and at Syracuse in New York; the difficulties of this system with our brines, and the advantages of evaporating in pans. It will contain a description of the method of making salt by solar evaporations, with suggestions for its introduction in the Goderich region, and the methods of refining and preparing salt for market; the whole based upon careful comparative studies made at Syracuse in 1868.

It will comprehend also observations on our iron ores, and the mode of working them; analyses of the Laurentian ores from various localities; investigations of the chemical composition of the iron sands of the lower St. Lawrence; descriptions of the direct method of extracting iron from ores in the bloomery fire, as practised in the United States and at Moisie, its advantages and economics in certain cases, as compared with puddled iron; a description of Ellershausen's process, and the probable utilization by it of our iron sands; with general remarks on the manufacture of iron and steel, based on studies at the Exhibition in Paris in 1867, and subsequent observations in Canada and the United States; as well as considerations on the use of peat, saw-dust and other cheap fuels.

Lastly, it will contain examinations and assays of gold-bearing ores from the Hastings district, with notes on the occurrence of gold there; assays of bismuth and antimonial ores from the same region, and other miscellaneous matter.

I have the honor to be, Sir,

Your obedient servant,

(Signed,) W. E. LOGAN.

SUMMARY REPORT

ON THE

GEOLOGICAL SURVEY,

BY

ALFRED R. C. SELWYN, Director.

Dated 2nd May, 1870.

PRINTED BY ORDER OF PARLIAMENT.

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1870.

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SUMMARY REPORT

OF THE

GEOLOGICAL SURVEY.

Geological Survey Office,
Montreal, 2nd May, 1870.

Sir,—In compliance with the terms of the Act establishing the Geological Survey of the Dominion of Canada, which makes it incumbent on the officer in charge to furnish annually, in May, a report of the progress of the work under his direction, I now have the honor to lay before you, for the information of His Excellency the Governor General, the following summary of the operations of the Survey since the date of the last report of my predecessor, Sir William E. Logan, F.R.S.

I have, &c.,
(Signed,) Alfred R. C. Selwyn,
Director of the Geological Survey.

To the Honorable Joseph Howe, M.P.,
Secretary of State for the Provinces.

Geological Survey Office,
Montreal, 2nd May, 1870.

Having arrived in the country in October of last year, and having been in charge of the Survey since the 1st December, only five months, I have, from personal observation, no knowledge of the districts previously reported on, nor of those explored during the past season.

In the last Summary Report of progress, by my predecessor, Sir William E. Logan, dated 1st May, 1869, it was stated that reports had been received from the various assistants, whose works of exploration were then mentioned, but that it would be necessary to defer their presentation to a future occasion.

Most of these reports are now in the press; they have been studied and revised; and, although the dates at which they were originally written have not been altered, additional facts, the results of further investigation, have been embodied in them, and when considered requisite, illustrative maps and sections have been prepared to accompany them.

Reports by Sir William E. Logan, and Mr. Edward Hartley, on the Pictou Coalfield, giving the results of one season's investigation by Sir William, and of two by Mr. Hartley, to December 1869, are also in the press; as well as one by Mr. James Richardson, of his exploration last season, on the north shore of the St. Lawrence, from the River Saguenay to Seven Islands Bay,

These, and other reports, will be published at an early date in a volume, uniform with those issued by the Geological Survey in 1863 and 1866.

The contents of this volume will be as follows, viz :—

1. Report 1867–1868, by Sir W. E. Logan, F.R.S., on a part of the Pictou Coal-field, Nova Scotia.
2. Report by Mr. Edward Hartley, F.G.S., on a part of the Pictou Coal-field, Nova Scotia.
3. Report by Mr. Robert Bell, F.G.S., on the Geology of some of the islands of the Manitoulin group.
4. Report by Mr. James Richardson, on the Lower Silurian rocks on the south side of the St. Lawrence, between the Chaudière and Rivière du Loup, with a map.
5. Report by Mr. H. G. Vennor, on the Geology of Hastings county, Ontario, with a map.
6. Report by Mr. Charles Robb, on the Geology of a portion of the counties of York, Carleton, and Victoria, in New Brunswick, with a map.
7. Reports by Dr. T. Sterry Hunt, F.R.S., 1. On the Goderich Salt Region ; 2. On Iron and Iron ores.
8. Report by Mr. James Richardson, on a Geological examination on the north shore of the lower St. Lawrence, from the Saguenay to Seven Islands Bay.
9. Report by Mr. Robert Bell, F.G.S., on the Geology of the Thunder Bay and Lake Nipigon regions, with a map.
10. Report by Mr. Edward Hartley, F.G.S., on Coals and Iron Ores of Pictou county, Nova Scotia.

APPENDIX.

Report by Mr. John Bell, M.D., M.A., on the Plants of the Manitoulin Islands.

The appendix to Mr. Hartley's report contains much interesting and valuable information respecting the characters and economic qualities, as steam and gas-producers, of the coals from the Pictou and Springhill, Cumberland county, Coal-fields. The facts recorded have been deduced, from a series of carefully made analyses, and from practical trials with railway and marine engines, carried out, either by Mr. Hartley himself, or under his immediate direction and superintendence. The details of the manner in which these trials were conducted, and other useful observations connected with the economics of coal, will be found in this report ; it contains also descriptions and analyses of Pictou County iron ores. A considerable portion of Mr. Hartley's time and attention was devoted last year to these experiments, and the results obtained, are considered so satisfactory, and of so great commercial importance, as to justify the investigations being continued, and extended to other districts. In this connection, and to show the value of such enquiries, Professor J. S. Newberry, a better authority than whom could not be quoted, says, in his address recently delivered to the Legislature of Ohio, 7th February, 1870, (pages 40–41,) when speaking of the coking coals of that state—"To investigate the peculiarities of the different seams of coal included in this class, and prescribe the best method to be pursued in their use, is a great and important duty to be performed by this or some other Geological Board, and one that will add millions annually to the revenues of our people. In order to show how important the work is, I will only refer to the manufacture of iron in our south-western counties, until recently, the most important centre of iron industry in the state. Here there is an abundance of excellent ore, and forty furnaces that have been for years using charcoal for its reduction. But the supply of fuel afforded by the forest growth of a country is comparatively small, and it has there been, already, to a large extent, exhausted. Now, this region

abounds in coal, though mostly of the coking variety; and it is evident that its prosperity and progress will hinge upon the intelligent adaptation of the coal found there, to the purposes heretofore served by charcoal. If the mineral fuel of this portion of the State can be successfully employed in the reduction of its ores, the iron manufacture may be expanded to an indefinite extent; without this, it must not only cease to advance, but diminish. Already an exhaustive investigation into the properties and adaptations of different Ohio coals has been begun by the Geological Corps. This should be continued until every owner of coal lands, in every county in the coal-area, shall know with accuracy how much, and what kind of coal he possesses, for what it is fit, how much it is worth, how it can be worked, and where it is to be marketed. It is not too much to expect that when this investigation shall have been completed, the industries of the State will be sensibly affected, and very much expanded by it."

These remarks apply in full force to the Dominion of Canada, within which there is abundance of iron ore, and also large quantities of coal, similar to that of Ohio, remaining undeveloped, chiefly for want of that accurate knowledge of its properties, and of the right means to be employed for its adaptation to the several purposes for which either wood, charcoal, or anthracite, have hitherto been used, at a cost often greatly exceeding that of the coals of the country, if intelligently applied.

By special request, Mr. Hartley is preparing a full report of his experiments, for the information of Lewis Carvell, Esq., General Superintendent of Railways in New Brunswick and Nova Scotia, through whose kindness in placing the requisite means at his disposal, he was enabled to carry out his investigations. He is also greatly indebted, to the kindness and wise liberality of the following Companies, and their officers: Mr. J. Hoyt, of the Acadia Coal Company, Mr. J. Dunn, of the Intercolonial Coal Company; the Prince Edward Island Steam Navigation Company; and Mr. J. Hudson, of the General Mining Association. Mr. Hartley's experiments are, it is believed, already sufficient to indicate that a very large annual saving can be effected in the cost of fuel on railways and steamers, and in manufacturing works, in some cases by the substitution of coal for wood or charcoal, and in all by a more accurate knowledge of the right system of firing, the requisite draft, and the proper construction of furnaces and fire-places.

Mr. H. G. Vennor has been occupied in completing and extending his investigations on the structure, distribution, and economic minerals of the several rock masses in the counties of Hastings, Peterboro, Addington, and Frontenac, in the Province of Ontario.

Last summer his observations were chiefly confined to portions of the counties of Addington and Frontenac, and have embraced an area of about eleven hundred and fifty square miles, in which he has determined and mapped the distribution of the various deposits. They do not differ essentially, in their mineralogical character, and associations from those of the same formations, previously mapped by Mr. Vennor, in the counties of Hastings and Peterboro, some of which have already been described in the geological Reports of former years.

The rocks to which Mr. Vennor's attention was devoted last summer, are divided, in descending order, into the following groups:—

C or 3. Dolomites, mica-slates, and calc-schists.
B or 2. Diorites, chlorite-schists and magnetic iron ores.
A or 1. Syenite, gneiss and crystalline limestone. (Laurentian.)

The precise relations of groups 2 and 3, to the Laurentian rocks, group 1, is a question which hitherto had not been satisfactorily determined. Last year this was mentioned by Sir William E. Logan, and he then stated they were all classed, provisionally, with the Lower Laurentian.

Mr. Vennor has, however, now succeeded in establishing the fact that the dolomites, calc-schists and mica-slates, division 3, lie unconformably on the syenite, gneiss and crystalline limestone of division 1; while the position to be assigned to the diorites, chlorite-schists and iron ores of division 2, still remains doubtful, and will require further investigation. The possibility has been suggested that the latter may represent some

part of the Huronian system, interposed unconformably to 1 and 2. At present, however, there appears to be no reason for separating it from division 3. The similarity, lithologically, of certain beds in the county of Hastings, belonging to this group, to portions of the Huronian series on the northern shores of Lake Huron, was noticed in 1865, by Mr. Macfarlane, (*vide* page 93, *Geology of Canada*, 1866); and it now seems not improbable that this will prove to be the real age of at least some of the groups of strata which were, last year, provisionally designated as the Hastings series. In any case, Mr. Vennor's determination of the true relations of the upper division of these rocks to the Laurentian system, is, on palæontological grounds, exceedingly interesting and important, as it extends the known range of *Eozoon Canadense* to a series of rocks resting unconformably on the Laurentian.

No very important addition has been made, this season, to our knowledge of the various economic minerals which have already been mentioned in previous reports of the Survey, as occurring in this region. Galena appears in several places, associated with veins of calc-spar and barytes, cutting the Laurentian rocks. The most important of these veins, and the only one hitherto worked, is situated in the township of Loughboro, and is known as the Frontenac Lead Mine. A full description of this mine will appear in a future report. It is also briefly noticed in the volume of reports now in press.

Gold and silver are reported to have been found in several new localities. Specimens have been collected from these, but with one exception, have not yet been analyzed. The specimen assayed, was taken from a vein in the township of Kennebec; it consisted chiefly of blende with small crystals of galena, in a calcareous and schistose matrix, and contained a small proportion of silver. White crystalline limestone, often compact, and suitable for building and ornamental purposes, is extensively developed at Marble Lake, in the township of Barrie, where it has already been quarried, to a limited extent, for local building purposes. It also affords excellent lime; a fine dolomite, often of a beautiful flesh color, is found here in thin beds associated with the limestone. In the same township, there are beds of a fine grained slate, suitable for whetstones.

The precise localities in which these economic minerals occur, will be given with further details, in a future report, and they will also be indicated on a map accompanying it. This map, a first edition of which accompanies Mr. Vennor's report for 1868–69, will likewise contain some important topographical information, not given in any map of the district previously published.

In the spring of 1869, Mr. R. Bell, was instructed to proceed to Lake Superior, to examine portions of its north-western shores, and especially the Thunder Bay region; and to investigate there the geological relations of the silver-bearing rocks, and the mode of occurrence and associations of the silver veins. He was likewise instructed to visit Lake Nipigon, if practicable, make a survey of its shores, and ascertain as much as possible of the geological features of the Nipigon basin. Rocks of Upper Silurian age, in a horizontal attitude, had been reported to occur on Lake Nipigon. It was considered important to verify this statement, because, if correct, it would imply that lands might be found there, fit for settlement, and which would also offer facilities for the construction of lines of communication westward, such as do not exist in the Laurentian region further south. Although, except in the form of boulders, no Upper Silurian rocks were met with, Mr. Bell's investigations have, nevertheless, not only greatly extended our knowledge of the distribution of the Upper Copper-bearing rocks of Lake Superior, thus enlarging the limits within which valuable deposits of silver and copper may be expected; but they have likewise served to determine the existence of a considerable area, in the Nipigon basin, well adapted for settlement, and also, that the physical contour of the country presents no serious impediment to the construction of an easy line of communication westward, whether by waggon-road or railway.

The shores and islands of Lake Nipigon are occupied for the most part by rocks, supposed to belong to the series provisionally classed as "the Upper Copper-bearing rocks." Their general lithological characters correspond with those of the rocks of the

same formation on the shores of Lake Superior, described in considerable detail in the *Geology of Canada*, 1863 and 1866, as well as in other earlier published reports of the Geological Survey. The general aspect, the mineral associations, and the physical condition of those rocks, as given in the description referred to, would seem, in the absence of either palæontological or stratigraphical evidence to the contrary, to associate them with formations of considerably later date than the Silurian Copper-bearing rocks of the Eastern Townships. Mr. Macfarlane has already, though on lithological considerations only, advocated this view, in a paper published in the *Canadian Naturalist*, for May, 1867, in which he considers them as probably of Permian age. Before it can, however, be established whether this supposition is correct, or the age of these rocks determined, further careful study, and exploration of the region is required.

I have already had the honor to submit a preliminary report by Mr. Bell, chiefly on the physical features of the country, and in reference to the construction of roads, or other lines of communication through it. His complete report, with geological details, accompanied by a map, on a scale of four miles to an inch, of Lake Nipigon and adjacent country, will be ready for presentation immediately, and probably be included in the volume now in the press. In constructing the map of those parts of the country that were not examined by Mr. Bell, and of which no surveys were available, Indian sketches, and such other sources of information as were considered reliable, have been used.

Mr. James Lowe, has made considerable progress during the season, in tracing the distribution of the crystalline limestone bands of the Laurentian system in the township of Rawdon, and north of the seigniory of Ramsay. The mineralogical characteristics and general aspect of these limestones have already been fully described in the Geology of Canada, 1863 and 1866. In the former, Sir William E. Logan has also pointed out the difficulties encountered in endeavouring to trace the very intricate arrangement and distribution of the different bands. To unravel and map these intricacies is, however, the only means by which a clear comprehension can be obtained of the geological structure of the region. It is also a work which has a special value in connection with future settlement, because almost the only tracts of fertile soil on the Laurentian rocks are found accompanying these crystalline limestone bands, and therefore a map on which their distribution is correctly depicted, will be a useful guide to the localities where there is land fit for cultivation, and in selecting the best lines on which to construct colonization roads. These limestones also afford excellent lime, and good ornamental marbles and building materials, which together with the numerous economic minerals, iron and lead ores, plumbago, apatite, pyrallolite, &c., mentioned in the Geology of Canada, 1863, as frequently associated with them, renders an accurate knowledge of their distribution of still further importance.

In New Brunswick, the investigations commenced in 1868, by Professor L. W. Bailey, of the University of New Brunswick, at Fredericton, and by Mr. J. F. Matthew, of St. John, were continued last year, and considerably extended. A manuscript report, with a sketch-map and sections, giving the results of their explorations, has been received, but, owing to the extremely complicated distribution of the formations to which their attention has been devoted, and to the want of reliable palæontological evidence, unexpected difficulties have arisen in attempting to arrive at a satisfactory solution of the intricate structure, and of the true geological sequence of the different rock masses in the region. It is, therefore, considered advisable to defer the publication of their conclusions till the evidence is again carefully examined and reconsidered, and additional facts obtained by further and more extended investigation.

Mr. Charles Robb was also engaged in New Brunswick, last summer, completing his investigations in the central and north-western portion of the province. The results of his labors will appear, together with a map of the area he has examined, in the volume of reports now being printed.

Further, I may mention two geological examinations that were made during the season in the province of Quebec, the one by Mr. W. M'Ouat, and the other by Mr. A. Webster.

These gentlemen were selected by Sir W. E. Logan, at the request of the Honorable J. O. Beaubien, Commissioner of Crown Lands, to accompany, for geological purposes, certain surveying parties sent out by the Provincial Government to make explorations in the country occupied by the Laurentian series of rocks, north of the St. Lawrence.

Reports of such observations as they were able to make, together with plans of the area examined, have been prepared and transmitted to the Quebec Government. In forwarding Mr. A. Webster's report and plan, Sir Wm. E. Logan says, "I regret they are "so meagre, but a single straight line, carried through the forest, from which there is no "opportunity to trace individual bands of rock for any great distance on the strike, can "scarcely be expected to give any general structural result, or any geological facts of "importance, except such as may be merely accidental."

The surface of the country examined by Mr. Webster, lying towards the head-waters of the St. Maurice River, is almost everywhere covered by debris, consisting of large and small boulders, gravel and sand, carrying a coat of mosses. Even the crowns and summits of the ridges were, from this circumstance, examined with difficulty to any considerable extent. Examination was further rendered difficult from the country being crossed in every direction by brooks, swamps, wind-falls, and *brulés*, and dotted with lakes and ponds. In thirty miles the line of examination intersected twelve small rivers, and well marked streams, and crossed eight lakes of various sizes. The prevailing rock is gneiss, forming a hilly country, the ridges conforming more or less to the strike of the rock, which is generally north-east, but varying occasionally to north-west. The timber, throughout the whole distance is of poor quality, and small size; only in a few places was there any soil met with fit for cultivation, and then in but limited patches. No limestone bands, or other minerals of economic value, were observed. From either extremity of the line surveyed, a wide extent of country could be overlooked from points of considerable elevation. To the south-westward there appeared a succession of undulations, covered by a growth of poor timber, and to the north-eastward the undulations rise into precipitous mountains, of even less promising appearance; the distance overlooked in each direction was estimated at not less than twenty miles.

The country examined by Mr. Walter McOuat extends from the recently surveyed township of Kiamica, on the River Lièvre, for about fifty-three miles, with an average breadth of about eight miles, in a north-east direction, to within a few miles of the head-waters of the St. Maurice River. It appears to present a somewhat more favorable aspect than that examined by Mr. Webster. It has throughout an undulating outline of ridges and valleys, the former seldom abrupt, and nowhere so rugged or broken as in the region occupied by Laurentian rocks further south. The surface is composed of soil and gravel, with numerous boulders, and the underlying rock is visible only at wide intervals; though probably it would appear more frequently, but for the thickly wooded character of the country, which favors a rank growth of moss, and an accumulation of vegetable mould.

The soil, for the first twenty miles, is described as apparently fertile. On the summits and slopes of all the more elevated ridges, fine sugar-maples, yellow birches, and other hard-wood trees abound; while on the lower elevations, and in the valleys, white birches, spruces, balsam-firs, and pines predominate. Hemlocks are met with, occasionally, as far as Lake Kiamica; and on the shores of the lake, butternut trees were seen. Much of this country would afford valuable agricultural land, were it not for the vast number of large boulders which are scattered over the surface.

Beyond the first twenty miles, though the soil is apparently unchanged, the country gradually assumes a bleaker and poorer aspect, and the maple, yellow birch and pine trees, are almost entirely replaced by white birches, small spruces and balsam-firs. On the ridges, in the vicinity of Stonehouse Lake, maples are again tolerably abundant, but inferior in size to those in the Lake Kiamica District.

Gneisses, micaceous and hornblendic schists, and quartzites, are the prevailing rocks. Out-crops of white, coarsely crystalline limestone were observed in several places, and are supposed to belong to one continuous band, the probable course of which is indicated

on the plan prepared by Mr. McOuat, and transmitted with his report. The general dip of the gneiss rocks appears to be southerly, at angles from 45° to 85°, while the greatest observed dip of the limestone did not exceed 60°, and the lowest was only 20°.

The only economic minerals, besides limestone, that were met with, are magnetic iron ore and graphite; the former was seen, in one place, in crystalline masses, in a vein; it also occurs in the form of sand, in considerable quantities, on the shores of Lake Kiamica, and was likewise observed occurring, in a similar manner, on the shores of Lac Brulé. Graphite was found only in very small quantities, chiefly in disseminated scales in a garnetiferous gneiss, and occasionally in the crystalline limestone. The opportunities for careful examination were so limited, that the circumstance of nothing more important having been observed, is not surprising, nor can it be considered as in any way affirming that valuable mineral deposits are altogether wanting in the district.

The variation in the aspect of the country will, doubtless, be found to be more or less connected with the run of the limestone bands, and probably the reappearance of the maples in the vicinity of Stonehouse Lake, where the limestone band again strikes the line of survey, may be thus accounted for.

Much of Dr. T. Sterry Hunt's time during the past year has been devoted to investigations in the field. He spent three months in New Brunswick, chiefly in company with Professor Bailey, in the examination of the crystalline rocks of that province, whose structure and relations are such as to require the aid of careful lithological and chemical studies for their elucidation. It was also found necessary that he should make some excursions through the states of Maine and New Hampshire, in order to connect the rocks of New Brunswick with those of the province of Quebec, and to correlate the results of the Canadian Survey with those of the geologists of these States.

The examination and study of the various collections of rocks and minerals made by the explorers of the Survey has also occupied a large part of his time, while the number of those who, either personally or by letter, consult Dr. Hunt about the economic mineralogy and the geology of the Dominion is now so great as to make continued claims on his attention. To these various duties has latterly been added the supervision of the publication of the volume of Survey reports; and but little time has been left for investigations in the laboratory.

At Dr. Hunt's request the services of a chemical assistant—Mr. Gordon Broome, F.G.S., a distinguished young Associate of the School of Mines, London—have been secured temporarily, and he has been occupied for the past three months, under Dr. Hunt's directions, with chemical work in the laboratory.

In December last year the first copies of Sir William E Logan's large Geological Map of Canada were received from the publisher, Edward Stanford, Charing Cross, London; and a further consignment arrived in February. These have been distributed to the following institutions, public officers, and private persons,—to the latter in return for substantial aid rendered, either in the construction of the map itself, or, generally, to the Geological Survey:—

H. R. H. Prince Arthur,	Montreal.
The Governor General,	Ottawa.
Parliament Library,	"
Secretary of State for the Provinces,	"
Minister of Agriculture,	"
Managing Director and Chairman, Grand Trunk Railroad,	Montreal.
Crown Lands Department,	Ontario.
Crown Lands Department,	Quebec.
Crown Lands Department,	New Brunswick.
Inspector of Mines,	Halifax, N. S.
Alexander Murray—Newfoundland Geological Survey,	St. John's, Newfoundland.
Col. Wolseley, Qr.-Master General's Office,	Montreal.
Laval University,	Quebec.
McGill University,	Montreal.

Queen's University,	Kingston.
University College,	Toronto.
University of New Brunswick,	Fredericton, N. B.
King's College,	Windsor, N. S.
Dalhousie College,	Halifax.
Professor James D. Dana,	New Haven, Conn.
Professor James Hall,	Albany, N. Y.
Smithsonian Institution,	Washington, D. C.
United States Coast Survey,	"

The cost of each copy of the map, in eight colored sheets, is two pounds ten shillings sterling, exclusive of freight and charges. It is much to be regretted that the Geological fund is not large enough to admit of a much wider gratuitous distribution of this magnificent and valuable map, of which it is not too much to say that it is a work the country may justly be proud of, and one reflecting the highest credit on the Geological Corps of Canada, and on every one engaged in its production.

In view of the beneficial results to the country likely to be secured by its diffusion, I had the honor, last February, to address the subjoined letter to the Honorable the Secretary of State for the Provinces, offering some suggestions respecting it, for the favorable consideration of the Government; and I hope means will yet be devised to secure a more general circulation for it, than can be anticipated if left to the ordinary course of sale.

Letter.

GEOLOGICAL SURVEY OFFICE,
MONTREAL, February, 1870.

SIR,—Numerous applications from scientific and literary societies, educational institutions, and private individuals, have been received by Dr. Hunt and myself, requesting to be presented with a copy of Sir W. E. Logan's large, geologically colored Map of Canada, recently published.

I do not consider I have, at present, any authority that would justify me in complying with these requests, without the special sanction and approval of the Government; more especially as to do so would involve a very considerable expenditure of Survey funds, which, even without extra outlay of this kind, barely suffice to meet the necessary annual charges for the maintenance of the Museum, and for the geological exploration of the vast area included in the limits of the Dominion, to which the investigations of the Survey now require to be extended. Nevertheless, considering the importance of developing the mineral and other resources of the country, and the certainty that a more accurate knowledge of its geography and geology must tend materially to promote this object, it seems very desirable that such a valuable map, affording as it does, the most comprehensive and reliable information on these points, should be widely known and frequently consulted. Under these circumstances, I should be glad to receive your instructions in the matter.

When Sir W. E. Logan's large work on the Geology of Canada was published, a sum of money was, I believe, appropriated by Parliament to defray the cost of distributing copies, both in Europe and America. I think, if a similar course could be adopted for the distribution of the map, it would be very desirable to do so. The cost of it to the Canadian Government, geologically colored, in eight sheets, would be £2 10s. sterling per copy. If copies are distributed in Europe, it would be best to have them sent direct from London, which could be done by sending a list of the destined recipients, with the requisite instructions, to the publisher, Mr. Edward Stanford, 6 and 7 Charing Cross, London, S.W.

Appended, I beg to hand you a list of public institutions,—literary, scientific and educational—and of private persons, to whom the map might be sent, and who would not only value it themselves, but would often be able to render it valuable to this country, in the manner before indicated.

I have the honor, &c.,

To the Honorable Joseph Howe, M. P. (Signed,) ALFRED R. C. SELWYN.
Secretary of State for the Provinces.

During 1869, Mr. Billings has been engaged re-arranging portions of the Museum, and much of his time has also been occupied in examining and determining the species and genera of the fossils collected by the explorers in various parts of the Dominion during the year. These are roughly estimated to comprise about 2,000 specimens; numbers of them are, however, too imperfect for determination, and very few of them sufficiently perfect for exhibition in the museum collections. Mr. Billings is further engaged investigating the structure, and the affinities of certain fossils—the crinoidea, cystidea, blastoidea, and trilobites. The results of these and other palæontological researches, when completed, will form a part of the second volume of the Palæozoic Fossils of Canada. In the meantime, they are being published, in a somewhat abridged form, in the Canadian Naturalist, the American Journal of Science, and the Annals of Natural History. The portions relating to the trilobites will be communicated to the Geological Society of London, by Sir William E. Logan. In this paper the legs of a trilobite are described for the first time. The specimen, in which Mr. Billings has made this interesting discovery, is a well preserved example of *Asaphus platycephalus*, from the Trenton limestone, at Ottawa, and so far as known, is at present unique.

BUILDINGS.

The building devoted to the purposes of the Museum and Office of the Geological Survey, is an old three-story stone dwelling-house, situated at the corner of St. Gabriel Street, and Fortification Lane. In a report of Mr. Rubidge, A.E., P.W., for 1869,* on the several public buildings of the Dominion under the control of the Public Works Department, I find it stated of the Museum and Office of the Geological Survey, that "the premises are, generally speaking, in good repair," and that "for years past, all the repairs, not exceeding $100.00 annually, have been paid for out of the Legislative appropriation, under Sir William E. Logan's charge;" and further that "for the past eight or ten years the Public Works Department has not incurred any expenditure on this property." In 1858, a few trifling additions were made to some of the out-buildings, by the Department of Public Works. The premises have been occupied by the Geological Survey since 1852, or about seventeen years, and during that period no expenditure whatever, except that above named, has been incurred on account of this property, by the Public Works Office. The amount, not exceeding $100, mentioned as having been annually expended on the premises, by Sir W. E. Logan, has chiefly been devoted to keeping the roof water-tight, and to absolutely essential and pressing internal repairs.

From the foregoing facts, it will readily be believed that the buildings, especially externally, and the premises generally, are now in a condition which makes it exceedingly desirable, if only on grounds of economy, that they should be thoroughly and substantially repaired, without delay.

The geological collections exhibited in the Museum have hitherto been restricted to specimens from the former province of Canada, now constituting the provinces of Ontario and Quebec, which, up to 1868, included the limits to which the operations of the Survey extended. The area has, however, since been greatly enlarged by the addition of the territories constituting the Dominion of Canada. Even for the comparatively small area of Ontario and Quebec, the accommodation afforded by the building is insufficient for

* Appendix No. 19, Commissioner of Public Works' Report, for 1869.

the exhibition of all the specimens of minerals, rocks, and fossils, necessary for the complete illustration of the mineralogy and the geology of those provinces; and no space whatever now remains to exhibit any of the specimens, from the other provinces, which are annually being added to the collection, in large numbers, but which have to be packed in boxes, and stored away, instead of being utilized to illustrate the published reports of the explorers, and the mineral resources of the country.

School of Mines.

Suggestions for the establishment of a School of Mines, in connection with the Geological Survey, have recently been submitted for the consideration of the Government, which, if carried out, would involve obtaining suitable accommodation. It has been proposed to effect this by erecting a three-story brick building, sixty feet by forty feet, on the ground in rear of the Museum. By such an addition to the premises, a two-fold purpose might probably be achieved at a comparatively small expense, viz: securing the accommodation required for the School of Mines, and likewise additional space for museum purposes, sufficient to exhibit collections illustrating the geology of those parts of the Dominion, which, under existing circumstances, can be only very inadequately represented.

Mineral Statistics.

In view of the importance and usefulness of mining records, and of complete and accurate statistics of mineral produce, it is thought desirable to endeavour, in future, to publish yearly, with the reports of the Geological Survey, a return of the mineral production of the Dominion. With this object in view, the annexed circular and blank form have been issued, and copies of it have been sent to all persons who, it has been ascertained, are actively engaged in mining, or in raising or manufacturing mineral products, and whose addresses were known. In circulating the printed form, either personal or written application has, in most cases, also been made to have the information asked for under the respective heads, given in as a complete a form as possible, and the object of the enquiry has, at the same time, been more fully explained. No great success can be expected at first, neither is it likely that the replies received will be of such a nature as to afford the requisite material for the compilation of as complete a statistical return as could be desired. The precise object of the enquiry will have to be familiarized, and its public utility more generally understood and appreciated. On the whole, however, the results already obtained, are very encouraging, and I have no doubt that by degrees a large amount of valuable information relating to the mineral produce of the Dominion, will be collected.

Mr. Edward Hartley has issued ninety-seven circulars, with explanatory letters. Eleven only of these have been returned filled up, in most cases very satisfactorily. He has also received fifteen letters, acknowledging the circular, and promising to return the form filled in with the information asked for. 200 copies of the circulars have been sent to the Honorable Robert Robertson, Commissioner of Mines and Public Works in Nova Scotia, who has kindly promised his assistance in distributing them there, and undertakes to see that they are put in the hands of every person engaged in mining, connected with his department, who would be likely to make any use of them.

Professor R. Bell has sent 169 circulars to eighty-four persons in Ontario and Quebec, some of whom have undertaken to distribute the duplicates sent to them to mine-owners in their respective districts, whose addresses were not known at the Geological Survey Office. Of these only, fifteen have as yet been returned; they are filled up very satisfactorily. Twenty more have been acknowledged, and the information promised. Sectional drawings of two mines have been sent with the returns, shewing the nature of the deposit and the extent of the working.

The scheme, so far, appears to meet with general approval, and no one to whom application has been made, has declined to give the desired information.

(Signed,) Alfred R. C. Selwyn,
Director of the Geological Survey.

DOMINION OF CANADA.

RECORDS OF MINES AND MINERAL STATISTICS.

It has been decided to institute, in connection with the Geological Survey, a systematic collection of Records of Mines and of Statistics of the production and consumption of Minerals in the Dominion. As it will be impossible to effect this, so as to secure reliable and valuable results, without the cordial co-operation of all persons interested in mining pursuits, Owners, Directors, Managers, and Agents of Mineral Properties, and Iron Masters, Smelters, and Metal Merchants, are invited, and respectfully urged, to lend their hearty assistance towards promoting the object in view.

The great and permanent value, to the Mining interests of a country, of such Records and Statistical information, when carefully collected and compiled, is so well recognized and established, that it does not need to be dwelt upon.

To facilitate the work, the annexed form has been prepared for circulation; and it is hoped no difficulty will be experienced in getting it promptly returned to this office, with as much information, under the respective headings, as can be conveniently given.

As the Mineral Statistics are intended for publication with the Annual Reports of the Survey, it is desirable that all Returns for the year should be sent in as early as possible, and in no case later than the 31st January.

Statements given in confidence will be used only to aid in the compilation of totals; and it is hoped that inability to reply fully, or even in part, to all the queries, will in no case be considered a reason for altogether withholding information, however scanty, which can be given without inconvenience.

Professor R. Bell and Mr. Ed. Hartley have been requested to undertake the collection and arrangement of the Returns; Professor Bell, in Ontario and Quebec; and Mr. Hartley, in Nova Scotia and New Brunswick.

ALFRED R. C. SELWYN,
DIRECTOR GEOLOGICAL SURVEY.

GEOLOGICAL SURVEY OFFICE,
Montreal, January, 1870.

DOMINION OF CANADA.

RECORDS OF MINES AND MINERAL STATISTICS.

Period from.....187 to.....187 Return of.....
Province of.....
County of.....

Name in full. Mine or other description of Property worked. Name of, and distance from, nearest Town, Railway Station or Port. Cost and mode of conveyance.....
Names of Owners, or of Company and Manager.....
Nature of Tenure and particulars of Terms, (Rent, Royalty, &c.).....
Total depth of mine. Name, average thickness, depth, and number of seams, beds, or veins.....
Number, dimensions, and depths, of shafts and stopes, and total length and dimensions of galleries, levels, drives, or other excavations.....
Total area worked,—in acres, cubic yards, or feet.....
Dates when { Discovered..... / First worked..... / Suspended, and cause. / Re-opened.....
Number of hands employed, men and boys; or total number of days' work. Miners or Quarrymen, Mechanics, Bankmen, Labourers, whether by Contract, Day-work or Tribute....
Average rate of wages, or earnings, of each class.....
Number of Horses employed in the mine, and on the surface.....
Number, H. P., and kind of Engines in the mine, and on the surface; also Whims, Whips, Cranes, Stamp Mills, Crushing-Rollers and Pumps, and whether worked by Steam, Water, Wind, and otherwise.....
Total cost or estimated value of fixed machinery; also of rolling-stock and plant.....
Total quantity, quality, and kinds of material raised or produced.....
Total quantity sold. Total value, and price per at the works or delivered.....
Quantity used on the works. Quantity on hand on the first January, 18 , and quantity on hand 31st December, 18 , from previous years.....
Total quantity crushed, reduced, or otherwise treated.
Produce per and process used.....
Destination of Produce. { Provinces..... / Neighbouring states... / Foreign countries.....

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Remarks.

Signature and address of person making the Return.

It is very desirable that Plans and Sections of the Mine, accurately drawn to scale, and showing surface and underground works, should, if possible, accompany the Return. After the first year the annual additions only would need to be given.

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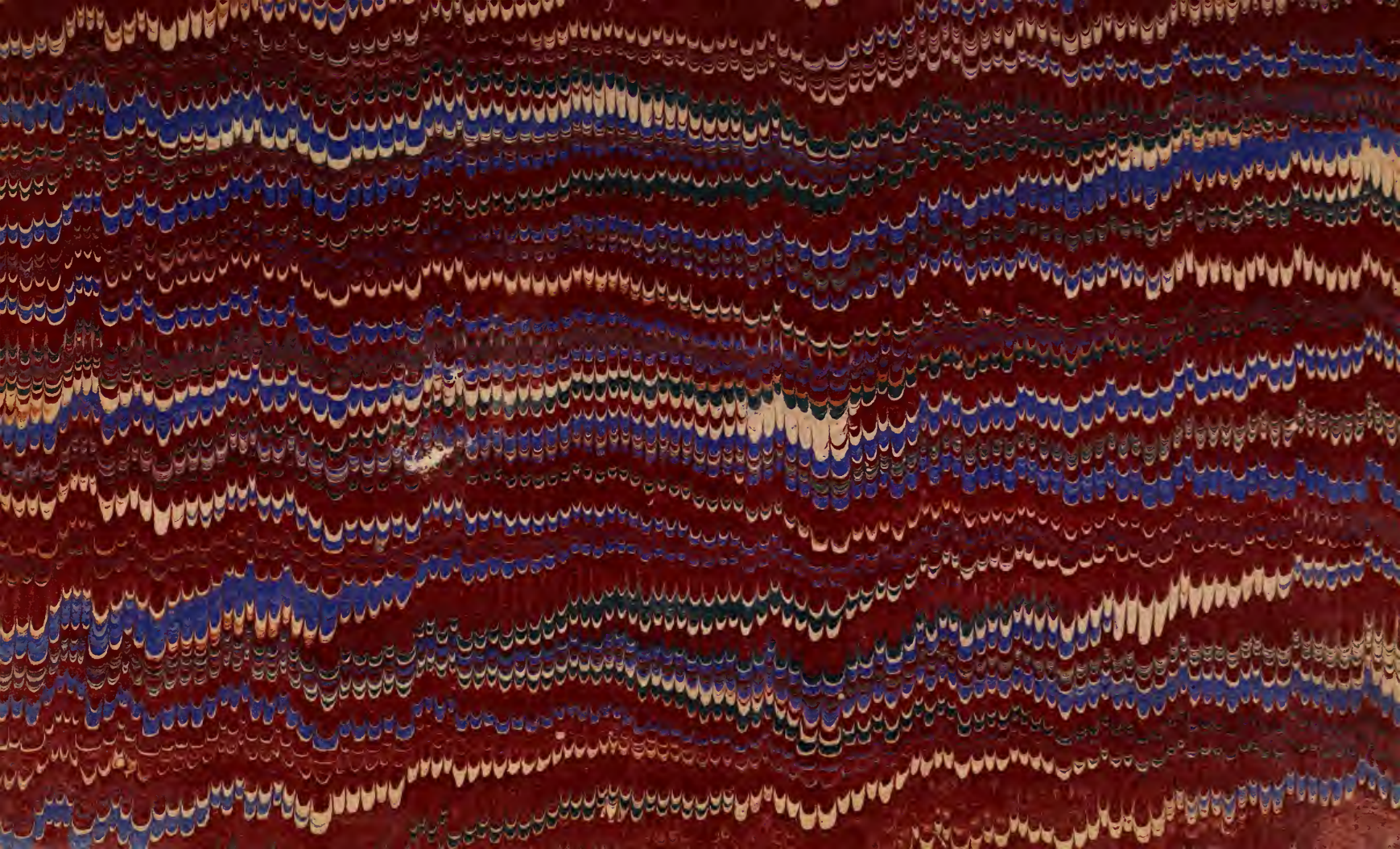

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